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THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY—VOL. XXIV.

TEXT.

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PACIFIC OCEANIC FISHERY
INVESTIGATIONS

REPORT

ON THE

SCIENTIFIC RESULTS

OF THE

VOYAGE OF H.M.S. CHALLENGER

DURING THE YEARS 1873-76

UNDER THE COMMAND OF

CAPTAIN GEORGE S. NARES, R.N., F.R.S.

AND THE LATE

CAPTAIN FRANK TOURLE THOMSON, R.N.

PREPARED UNDER THE SUPERINTENDENCE OF

THE LATE

Sir C. WYVILLE THOMSON, Knt., F.R.S., &c.

REGIUS PROFESSOR OF NATURAL HISTORY IN THE UNIVERSITY OF EDINBURGH
DIRECTOR OF THE CIVILIAN SCIENTIFIC STAFF ON BOARD

AND NOW OF

JOHN MURRAY

ONE OF THE NATURALISTS OF THE EXPEDITION

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PACIFIC OCEANIC FISHERY
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CONTENTS.

Report on the Crustacea Macrura dredged by H.M.S. Challenger during the years 1873–1876.

By C. Spence Bate, F.R.S., &c.

EDITORIAL NOTE.

The Report on the Crustacea Macrura, by C. Spence Bate, Esq., F.R.S., forming Part LII. of the Zoological Series of Reports, occupies the whole of the present volume, the text, which consists of 1032 pages with a large number of woodcuts, being bound up separately from the 157 lithographic plates. The collection was sent to Mr. Spence Bate in December 1877, so that the preparation of the Report has engaged his attention for over ten years. The Manuscript was received by me in instalments between the 9th December 1880 and the 20th March 1888.

An Appendix to this Report by Dr. P. P. C. Hoek treats of a parasitic Cirriped, *Sylon challengeri*, attached to a Macrurous Crustacean, *Spirontocaris spinus*. This Appendix is accompanied by 2 lithographic plates. The Manuscript was received by me on the 14th May 1887.

John Murray.

Challenger Office, 32 Queen Street,
Edinburgh, 8*th May* 1888.

ERRATA.

Page xxxiii, line 8, for "*Cancrinos*" read "*Cancrinus.*"
Page 7, line 16 from below, for "*Tripæa*" read "*Trypæa.*"
Page 11, line 4, for "*Callocaris*" read "*Calocaris.*"
Page 46, line 11 from below, for "*Callocaris*" read "*Calocaris.*"
Page 88, line 6 from below, for "*gundulachi*" read "*gundlachi.*"
Page 104, line 9 from below, for "*enthrix*" read "*euthrix.*"
Page 219, line 17, *for* "Euphausidæ" *read* "Euphausiidæ."
Page 345, line 1 from below, for "*Sciacarus*" read "*Sciacaris.*"
Page 497, line 3, for "*Plesionika*" read "*Nothocaris.*"
Page 582, line 5 from below, for "*Caradina*" read "*Caridina.*"
Page 644, line 5 from below *for* "Station 164A" *read* "Station 164B."
Page 644, line 4 from below, *for* "1200 fathoms" *read* "410 fathoms."
Page 644, line 3 from below, *delete* "associated with *Nothocaris rostricrescentis.*"

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the Crustacea Macrura collected by H.M.S. Challenger during the Years 1873–76. By C. Spence Bate, F.R.S., &c.

PREFACE.

The Crustacea Macrura brought home by the Challenger Expedition were placed in my hands for examination and description by the late Sir C. Wyville Thomson, and the progress of the work has gone on under Mr. John Murray, the present Director of the Challenger Publications. The specimens, which were obtained by the dredge, trawl, tow-nets, or by other means, number about 2000, and, arranged according to species and localities, are preserved in about 400 bottles. All these have been carefully examined, the relative numbers of the sexes in most cases determined, and the anatomy and structure of one or more specimens of each species studied and figured, except where the specimens were too few to allow of their being broken up and dissected.

In making both the descriptions and drawings I have always felt that I was dealing with specimens of more than ordinary interest, since they were in many instances obtained from localities which are not likely to be again explored for some time, and which are scattered over a vast area of the Atlantic, Pacific, and Indian Oceans. Here I wish to express my indebtedness both to Mr. T. Wemyss Fulton, M.B., of the Challenger Editorial Staff, and to Mr. J. C. Richards, the former for his aid in watching the Report through the press, and the latter for his careful rendering of my drawings on the stone.

During the cruise, which lasted over three years and extended to some 70,000 miles, Macrura were obtained at 140 of the 277 stations at which trawling or dredging took place, in depths varying from 20 to 3000 fathoms, or, including those collected by the tow-net, from the surface down to about four miles.

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INTRODUCTION.

NOMENCLATURE.

Before entering upon the description of the structure of the many forms which I have to elucidate, it is necessary that the system of nomenclature which I have adopted should be clearly set forth and understood. It is the same as that which was used by Professor Westwood and myself in our History of the British Sessile-Eyed Crustacea, and which has since been extensively employed by naturalists.

I have invariably adopted the terms proposed by others when they appeared to possess clear homological value, and have only abbreviated most of those of Professor Milne-Edwards in order to avoid redundancy,—for example, in the terminology applied to the various joints of the oral and ambulatory appendages. Some of the terms in common use I have observed to be a frequent cause of confusion, even in printed descriptions, from their similarity in sound. I allude to the terms "endopodite," "exopodite," "apopodite" and "epipodite,"—the last three being applied to branches of the first, a fact which is not at all brought out by their respective names.

The nomenclature here employed appears to be of universal application to the whole of the Crustacea, and avoids the necessity for roundabout explanation, which so frequently destroys clearness of description.

In the definition and diagnosis of species I have confined myself to the systematic terms as given in the accompanying table, but when writing where less exactitude was necessary, I have generally used the more popular expressions.

The nomenclature of the parts is shown in the accompanying woodcut (Fig. I.) of an ideal Macrurous Crustacean, in which the appendages are represented of several characteristic forms.

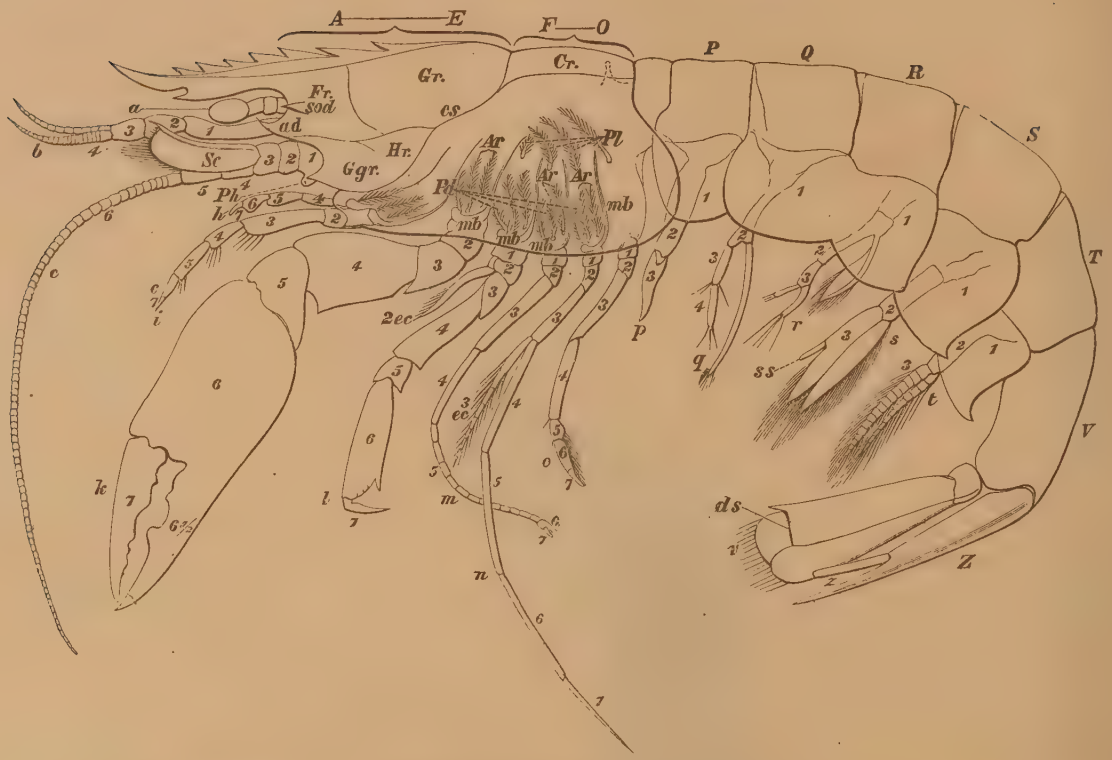

FIG. I.—Showing the nomenclature of the various parts.

Fr. Frontal region.
Gr. Gastric region.
Cr. Cardiac region.
Hr. Hepatic region.
Ggr. Antennal or green gland region.
A–E. Cephalic somites.
F–O. Thoracic or pereionic somites.
P–V. Pleonic somites.
sod. Supraorbital tooth.
ad. First antennal tooth.

Ophthalmus, . Eye.

Ocellus, . . A little eye, distinct from the main organ of vision.

a. Ophthalmopod, The appendage that supports the main organ of vision; it includes the eye, the peduncle, and the pedicle. Adapted from *Podophthalmitus* (Stimpson).

Metope, . . . From μέτωπον, face, being that portion of the frontal surface in which the antennæ are situated (Huxley).

b. First antenna, . Or antennule.

Blepharis, . . Fringe of hairs that surround the margin of the depression in which the eye lodges on the upper surface of the first joint of the first antenna; from βλεφαρίς, eyelash.

pc. Prosartema, . Appendage connected with the inner side of the first joint of first pair of antennæ; προσάρτημα, appendage.

stc. Stylocerite, . . Style or large spine on outer margin of the first joint of the first pair of antennæ; στύλος and κέρας.

c. Second antenna.

Sc. Scaphocerite, . Scale-like appendage of the second pair of antennæ (after Milne-Edwards).

Ph. Phymacerite, . Tubercle at base of second antenna, containing external orifice of the green gland; φῦμα, tubercle, and κέρας.

An. Ancecerite, . A curved process attached to the peduncle of the second pair of antennæ in *Benthesicymus*; from ἀγκὴ and κέρας.

ea. Epistoma, . . Osseous portion of the metope that lies immediately in front of the oral aperture (Milne. Edwards).

eg. Cheiloglossa, . Anterior lip. Membranous protuberance that lies in front of the mandibles and is continued under them; χεῖλος, lip, and γλῶσσα, tongue.

ma.	Metastoma,	Posterior lip of authors. Membranous appendage that lies behind and over the mandibles (Huxley).
d.	Siagon,	Mandible, *σιαγών*, a little jaw (after Westwood and Bate).
	Synaphipod,	Appendage attached to mandible; from *συναφής*, continuation, *ποῦς*, foot. This name is suggested as being homologically true. Popularly called "palp."
ap.	Apophysis,	Internal process of the mandible (Huxley).
	Psalistoma,	Cutting margin of the mandible; from *ψαλίς*, scissors, *στόμα*, mouth.
e.	1st siagnopod,	Or maxilla.
f.	2nd siagnopod,	Or maxilla.
g.	3rd siagnopod,	Or 1st maxilliped.
1.	Coxa,	First joint of any appendage from *a* to *v* abbreviated from coxagnathite and coxapodite of Milne-Edwards.
2.	Basis,	Second joint of any appendage from *a* to *v*, instead of basignathite and basipodite of Milne-Edwards.
3.	Ischium,	Third do. do. ischiognathite and ischiopodite do.
4.	Meros,	Fourth do. do. merognathite and meropodite do.
5.	Carpos,	Fifth do. do. carpognathite and carpopodite do.
6.	Propodos,	Sixth do. do. prognathite and propodite do.
7.	Dactylos,	Seventh do. do. dactylognathite and dactylopodite do.
ec.	Ecphysis,	Branch of any particular joint, from *ἔκφυσις*, as coxecphysis, a branch springing from the coxa; basecphysis, a branch springing from the base. The former is synonymous with epignathe and epipodite of Milne-Edwards, and sometimes with the podobranchia of Huxley, when it is connected with a branchial plume as in *Homarus*, &c. The latter (basecphysis) is synonymous with exognathe and exopodite of Milne-Edwards, and is preferred because it more clearly identifies the true relative position of the structure homologically.
mb.	Mastigobranchia,	The branchial lash; from *μάστιξ*, whip, and *βράγχια*, gills. It is synonymous with epipodite and epignathe of Milne-Edwards, and sometimes part of the podobranchia of Huxley, and with apodemata, MacCoy, and flabellum of old authors.
Pd.	Podobranchia,	A branchial plume attached to the coxa (Huxley).
Ar.	Arthrobranchia,	A branchial plume attached to the membranous articulation between the coxa and the body of the animal (Huxley).
pl.	Pleurobranchia,	A branchial plume issuing between the somites of the pereion (Huxley).
prk.	Pereicleis,	Tubercle attached to the last somite of the pereion that secures the carapace posteriorly; from pereion and *κλεὶς*, bolt.
ptk.	Peltecleis,	Tubercle attached to the posterior margin of the carapace; from *πέλτη*, shield, and *κλεὶς*, bolt.
plk.	Pleocleis,	Tubercle attached to the first somite of the pleon, and precludes the carapace from being raised posteriorly.
ptm.	Petasma,	Membranous development attached to the first pair of pleopoda in the male; from *πέτασμα*, a curtain.
	Thelycum,	Structure on the ventral surface of the pereion peculiar to females; from *θελυκὸν*.
ss.	Stylamblys,	A small process attached to the inner branch of the pleopod; from *στύλος*, style, and *ἀμβλύς*, blunt.
cc.	Cincinnulus,	Small hooks attached to the stylamblus, from *κικιννλος*, a curl (Sars).
ds.	Diæresis,	The division in the outer branch of the posterior or caudal pleopod; from *διαίρεσις*, division.
vz.	Rhipidura,	The posterior pair of pleopoda and the telson, when these parts are developed as in the Macrura; from *ῥιπίς*, a fan, and *οὐρά*, tail.
Z.	Telson,	Terminal somite of the pleon.
	Brephalos,	Name used for the young just as it quits the ovum, in whatever stage.

Throughout the Report the somites are recognised by capitals, and the corresponding appendages by small letters.

SOMITES.		APPENDAGES.	SYSTEMATIC.	POPULAR.	DANA.	MILNE-EDWARDS. SOMITES.	MILNE-EDWARDS. APPENDAGES.
Cephalon.	*A*	*a*	Ophthalmopod,	Eye, Peduncle, and Pedicle.	Oculus		Eye.
	B	*b*	1st Antenna,	1st Antenna.	Antenna I.		Antennule.
	C	*c*	2nd „	2nd „	„ II.		Antenna.
	D	*d*	Siagon,	Mandible.	Mandible		Protognathe.
	E	*e*	1st Siagnopod,	1st Maxilla.	Maxilla I.		Deutognathe.
Pereion.	*F*	*f*	2nd „	2nd „	„ II.		Tritognathe.
	G	*g*	3rd „	3rd „ or 1st Maxillipede or Jawfoot.	Maxilliped I.		Tetartognathe.
	H	*h*	1st Gnathopod,	2nd „	„ II.	Protosomite,	Pemptognathe.
	I	*i*	2nd „	3rd „	„ III.	Deutosomite,	Hectognathe.
	K	*k*	1st Pereiopod,	1st Leg or Arm.	Ped. Prehensile	I. Tritosomite,	Bras,
	L	*l*	2nd „	2nd „	„ „	II. Tetartosomite,	
	M	*m*	3rd „	3rd „	„ „	III. Pemptosomite,	Pattes Ambulatoires.
	N	*n*	4th „	4th „	„ „	IV. Hectosomite,	
	O	*o*	5th „	5th „	„ „	V. Hebdosomite,	
Pleon.	*P*	*p*	1st Pleopod,	Swimmerets or Abdominal Appendages.	Appendage I.		
	Q	*q*	2nd „		„ II.		
	R	*r*	3rd „		„ III.		
	S	*s*	4th „		„ IV.		
	T	*t*	5th „		„ V.		
	V	*v*	6th „		„ VI.		
	Z		Telson.	...	...		

Cephalothorax. — Abdomen. — Thorax.

MORPHOLOGY.

Milne-Edwards laid it down in his earlier writings that the type of the Decapod Crustacea consists of twenty-one somites, of which the anterior seven belong to the cephalon or head, the posterior seven to the pleon or abdomen, and the intermediate seven to the pereion or thorax.

Dana admits that there are normally twenty-one segments, and twenty-one corresponding pairs of appendages, the posterior seven of which belong to the pleon. But he says that of the remaining fourteen pairs, only five are subservient of locomotion, the other nine being organs of special sense or in relation to manducation and placed about the mouth. In reaching this conclusion, Dana was guided by the results of his examination of the Brachyura and higher Macrura, in which the nervous system is most highly centralised.

From the study of development as well as of the adult structure of the more simple forms of Crustacea, I previously adopted and maintained the view put forward by Milne-Edwards. But since then, from the examination of extensive series of Crustacea of all groups and types, and of many forms in different stages of development, I have been led to reconsider this conception of the structural relationship of the several parts.

If we turn to the development of the Synaxidea we find some of the most instructive examples of crustacean form. In this group the animal leaves the egg far advanced beyond the Zoea stage, and exists in what Anton Dohrn calls the Megalopa stage; although in character it is far below the form to which Leach originally gave that name, and which was ultimately shown to be an advanced stage of a young Brachyura. It is extremely thin and very translucent, and a more advanced form has been named *Phyllosoma* by Milne-Edwards. At the period when it is hatched it is about 2 mm. in length (Pl. XIIA. figs. 1, 2), and is distinctly divided into three separate parts. The anterior portion or cephalon is broad and shield-like, and represents the future carapace of the adult; the second portion or pereion is also broad and disc-like, and it was upon the characters of these two divisions that a supposed family was established by Milne-Edwards under the name of Bicuirassés; the third portion or pleon is a narrow terminal process.

The cephalon consists of the ocular, the two antennal, the mandibular, and the first post-oral somite (Pl. XIIB. fig. 1; Pl. XIIC. fig. 2). The two anterior somites, as shown in the adult animal, are separate from those which form the large dorsal shield or carapace. Studying the development of the *Phyllosoma* still further in various species, we find that the succeeding somites are distinct from the cephalon and together compose the pereion; consequently the whole of the appendages attached to this division must be

pereionic, and it would therefore appear that there must be five somites (A to E) only belonging to the first division or cephalon, nine (F to O) to the second or pereion, and seven (P to Z) to the third or pleon.

In the mature forms the encroachment of one part on the other is so marked and conspicuous that several of the more crowded appendages lose their simple character and adapt themselves to the functions of those with which they are brought into closer affinity; thus the anterior pairs of pereiopoda, which are true feet in the simple forms, become hands, and then in still closer resemblance to the oral appendages, until in the more highly developed forms the second pair of gnathopoda loses its pediform character and becomes in the Brachyura little more than opercula, covering the mouth. Another fact brought out in the study of these and other immature forms during the progress of their development is that the carapace is structurally independent of the pereion, in which the somites are complete in the young condition, as may be seen in the series figured in Pls. XIIA., XIIB., XIIC., XIID., but that as the animal increases in size the carapace of the cephalon encroaches upon and covers over the surface of the pereion, the dorsal arc of which ceases to be formed; and thus the carapace appears as part of the pereion which it covers. But this is not always the case, for in the genus *Eucopia* nearly, if not all, the somites of the pereion are perfect, while the carapace overlies them all. In this case, however, the pereion is of a soft and membranous structure, and has therefore little protective value, whereas in the stronger forms, the carapace forming an efficient protection, the inner calcified structure of the somite is not wanted.

The carapace is also capable of fulfilling offices that simple somites could not carry out. It forms a great shield that is capable of protecting a greater or less portion of the animal, varying from the entire body in some of the Brachyura to but little beyond the cephalon in *Lucifer*.

This protective character is further exemplified in the Macrura, particularly in the fast swimming forms, by the development of a long rostrum at the anterior extremity, which is evidently intended to break the force of any body with which it may come into contact, and so protect the eyes and sensory organs from injury. The rostrum may also in some cases be used as a weapon of offence, the teeth that adorn it increasing its value in this respect; in some cases the latter have a retaining power, when, as in *Nothocaris spiniserratus* and *Odontolophus serratus*, the teeth are supplemented by numerous small reversed teeth attached to the others.

The rostrum is generally firmly fixed and rigid, but in one or two genera, such as *Pantomus* and *Rhynchocinetes* of A. Milne-Edwards, the rostrum has an articulation with the frontal margin of the carapace, and seems to have the power of movement to a slight extent in any direction at the will of the animal; this modification can be due only to one purpose, that of receiving the shock of an approaching enemy directly on its point rather than obliquely.

The teeth also that are placed upon the frontal margin of the carapace are probably less offensive than protective, since they generally are situated at points where muscular attachment is required, and the strength of the integumental tissue is by their presence increased.

Although the carapace has the capacity of being elevated posteriorly at the will of the animal, it is nevertheless generally kept in position by strong points of resistance, and these vary in form, position, and character in different families and perhaps in genera also. In *Palinurus* they exist as large, flat, button-shaped tubercles on each side of the pereion and are inserted into hollow cavities on the under surface of the carapace, and the power of retention is very great. To such a tubercle I have applied the name pereicleis, since it bolts the carapace to the pereion (Pl. XII. fig. 1, *Palinosytus*[1]; fig. 2, *Panulirus*).

In other genera, such as *Thaumastocheles* (Pl. VI.), *Ibaccus* (Pl. VIII.), and *Pentacheles* (Pl. XVI. fig. 4), there is a process or tubercle on the pleon that overlaps the carapace, and keeps it in position. This I have named the pleocleis. In some few instances, as in *Willemœsia*, the tubercle originates from the posterior margin of the carapace and lodges in a groove or hollow in the surface of the first somite of the pleon; this I have named the peltocleis. But in many genera the carapace is produced posteriorly on each side to a considerable extent, and while overlapping the first somite of the pleon is itself overlaid by the anteriorly projecting wings of the second somite.

The Branchiæ.—The great value of this power of securing the carapace is that it gives protection to the branchiæ which are placed beneath it.

Where the carapace does not exist, the branchiæ are of a more simple character and are generally pendent from the leg, as in the Amphipoda, or attached to other parts of the animal, as in the Squillidæ and Isopoda, or are absent altogether as in *Lucifer*. But in the well-developed forms of Macrura the branchiæ assume a higher character than mere appendages of the legs.

It is true that one pair (the podobranchiæ) belong to the first or coxal joint of the legs, and these are developed largely and most constantly in the normal group of the Trichobranchiate division, being absent only in two genera, and in some of the normal forms of the Dendrobranchiata, as in the genera *Benthesicymus*, *Aristeus*, and their near congeners; but they are absent in *Penæus*, *Sicyonia*, and *Sergestes*, and rudimentary in *Haliporus*.

In the Phyllobranchiate division the podobranchial plume is invariably absent from all the pereiopoda, but it is present—except in only a few genera, such as *Nika*, *Crangon*, and *Glyphocrangon*—on the first pair of gnathopoda, and in the fresh-water genus *Atya*

[1] A. Milne-Edwards having employed *Palinustus* for the name of a new Scyllarid, I have changed the name of my genus from *Palinostus* to *Palinosytus*.

it is present on the second pair also; and these are never present without being attached to a mastigobranchial appendage. This is true of each separate division, both normal and aberrant, with the following exceptions:—viz., *Cheramus* in the Trichobranchiata, *Latreutes* and *Atya* in the Phyllobranchiata. Of these the two former are small specimens, and the mastigobranchia may have been overlooked, and it is present on the second gnathopod in *Atya*.

In the genus *Stereomastis* there is only one mastigobranchia, and that is attached to the second pair of gnathopoda and is in a rudimentary condition (p. 158, fig. 37); there are, however, four podobranchiæ attached to the anterior four pairs of pereiopoda, but in this genus they are projected on a stalk and the mastigobranchia has become obsolete and the podobranchia reduced to a degree, which appears to be further advanced than is seen in *Pentacheles euthrix*, where the mastigobranchiæ exist as plates of exquisite delicacy.

In the family Astacidæ the majority of the genera are tabulated as having six pairs of podobranchiæ and only one mastigobranchia, *Cambarus* and *Astacus* having none; but the fact is that the mastigobranchia in this family is connected with the podobranchial plume throughout the whole of its length in the manner shown in Pl. XXVII. fig. 1, *pb*, and in fig. 1*m*″. This I think may be understood from a knowledge of the fact that in their development the mastigobranchial plate and the podobranchial plume commence in one sac, which afterwards divides by forming a branch that is without branchial filaments, as may be seen in Pl. XIIB. fig. 4, *g*. But whether they be united or distinct from the branchial plume they fulfil the same office, that of separating one set of branchial appendages from another, and sending long serrate hairs between the filamentose rods, and thus keeping them free from undue lateral pressure, as may be seen in Pl. VII. figs. 1 and 1 *bis*, and Pl. XXVIII. *pd.br*.

In many instances, especially where the podobranchiæ are not developed, the mastigobranchiæ are small; but though small they can scarcely be considered as rudimentary, seeing that they are developed upon a general plan, and that one of usefulness. In Pl. CVII. fig. *mb*., and Pl. CVIII. fig. *i*″, where they are figured as developed with a hook at the extremity, varying in form, they reach only to the extremity of the next succeeding branchia, and sometimes, as in *Atya* (Pl. CXIX. fig. 1), they terminate in a brush of long hairs that penetrate between the plates of the different plumes.

The arthrobranchiæ, or those branchiæ attached to the membranous articulation that connects the legs with the body of the animal, are the most abundant and very constant throughout the Macrura. They appear to be present in all the genera alluded to in this Report, with the exception of *Pontophilus*, *Sabinea*, *Pontocaris*, *Nika*, *Paralpheus*, *Synalpheus*, *Latreutes*, *Hippolyte*, *Spirontocaris*, *Hetairus*, and *Pontonia*. There is only one arthrobranchia in *Alpheus*, and that is attached to the second pair of gnathopoda.

The pleurobranchiæ, if not the most numerous, are perhaps the most constantly

present, being absent only in those genera of the aberrant Trichobranchiata that approximate to the Anomural type; but, strange to say, *Cheiroplatea*, or the most Anomural form of the group, has three pairs of pleurobranchiæ.

These statements will, however, be better understood by an examination of the following tables, which are compiled from a large series of specimens of different species of the several genera :—

Tribe.	Group.	Family.	Genus.	Mastigobranchiæ.	Podobranchiæ.	Arthrobranchiæ.	Pleurobranchiæ.
TRICHOBRANCHIATA	ABERRANTIA	PYLOCHELIDÆ, . .	*Cheiroplatea*, .	...	...	10	3
		THALASSINIDÆ, . .	*Thalassina*, .	5	4	12	...
		CALLIANASSIDÆ; .	*Callianassa*, .	1	...	10	...
			Cheramus, .	...	1	8	...
			Scallasis, . .	...	...	9	...
		AXIIDÆ, . . .	*Paraxius*, .	6	4	10	...
			Eiconaxius, .	6	4	8	...
		THAUMASTOCHELIDÆ,	*Thaumastocheles*,	6	5	10	4
	NORMALIA	SCYLLARIDÆ, . .	*Ibaccus*, . .	6	6	12	4
		PALINURIDÆ, . .	*Panulirus*, .	6	6	10	4
			Palinurus, .	6	6	10	4
		ERYONIDÆ, . . .	*Polycheles*, .	5	4	8	4
			Pentacheles, .	5	4	8	4
			Stereomastis, .	1	4	8	4
			Willemœsia, .	5	4	8	4
		HOMARIDÆ, . . .	*Phoberus*, .	6	6	10	4
			Nephropsis, .	6	5	8	4
			Nephrops, .	6	5	10	4
		ASTACIDÆ, . . .	*Paranephrops*,[1]	1	6	11	4
			Astacopsis, .	1	6	11	4
			Cherops,[1] . .	1	6	11	4
			Astacoides, .	1	6	9	1
			Engæus,[1] . .	1	6	11	4
			Astacus, . .	...	6	11	1
			Parastacus,[1] .	1	6	11	4
			Cambarus,[1] .	...	6	11	...
		STENOPIDÆ, . . .	*Stenopus*, . .	7	1	11	6
			Spongicola, .	6	1	12	6

[1] According to Huxley.

Tribe.	Group.	Family.	Genus.	Mastigobranchiæ.	Podobranchiæ.	Arthrobranchiæ.	Pleurobranchiæ.
DENDROBRANCHIATA	NORMALIA	PENÆIDÆ,	*Penæus*,	5	...	11	7
			Pleoticus,[1]	6	1	11	6
			Artemesia,	4	1	11	6
			Haliporus,	6	3	12	6
			Sicyonia,	5	...	6	6
			Hemipenæus,	5	4	11	6
			Aristeus,	6	5	11	7
			Hepomadus,	5	4	11	7
			Benthesicymus,	6	5	12	6
			Gennadas,	6	5	12	7
		SERGESTIDÆ,	*Sergestes*,	...	...	...	4
			Acetes,	...	...	...	9
			Lucifer,	...	...	...	0
PHYLLOBRANCHIATA	NORMALIA	CRANGONIDÆ,	*Crangon*,	2	...	2	4
			Pontophilus,	2	1	...	6
			Sabinea,	2	1	...	6
			Pontocaris,	1	1	...	6
		NIKIDÆ,	*Glyphocrangon*,	...	...	4	6
			Nika,	...	...	...	5
		ALPHEIDÆ,	*Alpheus*,	7	...	1	5
			Paralpheus,	1	1	...	5
			Synalpheus,	1	1	...	5
		HIPPOLYTIDÆ,	*Latreutes*,	...	1	...	5
			Hippolyte,	1	...	...	4
			Spirontocaris,	5	1	...	5
			Nauticaris,	6	1	6	6
			Hetairus,	4	1	...	5
			Chorismus,	4	1	1	5
			Merhippolyte,	6	1	5	6
			Amphiplectus,	1	1	4	5
		PANDALIDÆ,	*Heterocarpus*,	6	1	5	5
			Plesionika,[2]	6	1	5	6
			Nothocaris,	6	1	5	5
			Pandalus,	6	1	5	5
			Chlorotocus,	6	...	5	6
			Dorodotes,	6	1	6	5
		ATYIDÆ,	*Atya*,	5	2	...	6
		PONTONIIDÆ,	*Pontonia*,	...	...	...	4

[1] The name *Philonicus*, which was originally given to this genus (p. 273), being preoccupied, I now substitute for it *Pleoticus*, from πλεοτικος.

[2] In *Plesionika spinifer* the numbers respectively are 1, 1, 5, 6.

Tribe.	Group.	Family.	Genus.	Mastigobranchiæ.	Podobranchiæ.	Arthrobranchiæ.	Pleurobranchiæ.
PHYLLOBRANCHIATA *continued.*	NORMALIA *continued.*	CARICYPHIDÆ,	*Acanthephyra*,	5	1	6	5
			Oplophorus,	6	1	5	5
			Campylonotus,	6	1	5	6
		PALÆMONIDÆ,	*Palæmon*,	1	1	1	5
			Bithynis,	1	1	1	5
			Brachycarpus,	1	1	1	5
		NEMATOCARCINIDÆ,	*Nematocarcinus*,	6	1	5	5
			Stochasmus,	...	...	...	...
		TROPIOCARIDÆ,	*Notostomus*,	5	1	5	6

The Ophthalmopoda.—Of the several somites that compose the body of the Decapod Crustacea, that which supports the organs of vision is the most anterior. This can be demonstrated by the course of the progressive development, even of the forms which depart most from a simple type, as well as by means of dissection, the most anterior branches given off from the cephalic ganglion going directly to the organs of vision. Theoretically, these organs are the lateral appendages of a somite which in many genera is not traceable; but among the Macrura it is frequently present in the form of a more or less distinct calcified bar, lodged between the inferior surface of the projecting front of the carapace and the tergal portion of the second or antennal somite (Pl. CXIII. fig. 1*a*–*a*), which sometimes is so much developed as to meet the advanced or rostral portion of the carapace, and thus enclose the first or ophthalmic somite within a channel. In such cases the ophthalmic somite frequently ceases to be a calcareous structure, and thus gives colour to the opinion held by many, among whom Claus and Fritz Müller[1] are the highest authorities, that the ophthalmopoda have no ocular somite, and therefore are not homotypical of the limbs attached to the other somites among the Arthropoda.

The ophthalmic somite as a distinct and limb-bearing segment is capable of being determined in several separate genera throughout the Crustacea, as, for instance, in *Squilla*, as shown by Milne-Edwards in his Histoire des Crustacés, and in *Palinurus vulgaris*.[2] In *Cancer pagurus* the ophthalmic somite exists distinctly separated from the others, but is enclosed as a calcareous bar, and hid within the first, or anterior,

[1] Facts and Arguments for Darwin, English Translation, p. 14, note 1, 1869.

[2] Brit. Assoc. Advancement of Science, 1877, Report on the Present State of our Knowledge of the Crustacea, pl. ii. fig. 8.

antennal somite, which in the Brachyura and Macrura is generally closely fused with the two succeeding.

The ophthalmopoda undergo various modifications of form throughout the order, but the most common condition is that of a pair of pyriform or subcylindrical appendages, the peduncles, each of which generally slightly enlarges towards the distal extremity, where it supports a reniform or hemispherical pigmented organ of vision, the ophthalmus; at the base the peduncle abruptly narrows and is supported on a slender pedicle, which varies in length, as may be observed by comparing that in the genus *Eretmocaris* (Pl. CXLV.) with that in *Palæmon* or *Astacus*, where the pedicle almost disappears. In *Alpheus* and its congeners, *Athanas* and *Cheirothrix* (Pl. XCVI. fig. 2*a*), the peduncle also undergoes diminution.

This pair of appendages is thus shown to be liable to undergo various changes in each of its parts, and these changes have a tendency to be associated more or less exclusively with the several divisions of the order.

Among the Trichobranchiata the ophthalmopoda are generally short and supported on a pedicle that is only sufficiently long to admit of the free motion of the peduncle, whereas the ophthalmus is generally hemispherical or reniform, the most normal condition being seen in *Homarus*, *Nephrops*, *Astacus*, and *Palinurus*, and the greatest departure may be found in the young of the last and in the aborted condition seen in *Willemœsia* and its congeners.

In the *Phyllosoma* shown on Pl. XIIA., whether it be the young of some one of the Palinuridæ or of the Scyllaridæ, the ophthalmopod, a short period after hatching, is projected on an extremely long pedicle, which is the more remarkable inasmuch as both in the brephalos condition (Pl. XIIA. fig. 1) as well as in the adult stage the organ is short and the pedicle reduced to the smallest condition consistent with free movement.

In *Phoberus* the ophthalmopoda are reduced to two small slightly movable processes, with a small globular ophthalmus, as they are also in *Nephropsis*, while in the aberrant genus *Thaumastocheles* they are absent altogether, or only represented by two small fixed calcified points.

During the expedition of the "Travailleur" A. Milne-Edwards took a species that he named *Richardina spinicincta*, in which the ophthalmopod is reduced to a sightless globe, surmounted by three strong teeth, and in a specimen of *Palinurus* he found that from the middle of the eye a multiarticulate appendage was produced.[1] According to Leydig[2] the eyes of *Cambarus pellucidus* (Tellkampf) have neither pigment, rods (bacilli), nor cones, and that while they differ in the adult condition from those in the more normal species, they are comparatively larger in the young than in the adult

[1] *Comptes rendus*, tom. lix. p. 710, 1864.

[2] Untersuchungen zur Anat. und Histologie der Thiere, 1883.

stage, a fact that is apparent in nearly all purblind species and is especially noticeable in *Alpheus* and *Willemœsia*, as may be seen by reference to Pl. LXXXIX. fig. 4, and Pl. XX. fig. 2.

In the several forms classified under the generic name of *Eryon*, the organs of vision appear to have become degenerated. In most specimens of the various fossil species, no trace of eyes has been detected. In the original specimens, as figured by Desmarest in his Considérations générales sur la classe des Crustacés, Pl. XXXIV. fig. 3, part of a biarticulate appendage is present on the frontal margin on each side, beyond the second pair of antennæ. If, as is possible, these are the remnants of the appendages that supported the eyes, I think we must come to the conclusion that they were projected at the extremity of a long or short pedicle.

In a specimen unearthed in 1882[1] from the Upper Lias strata of Calvados and described by M. Morière, the general features bear a resemblance to the *Willemœsia* of

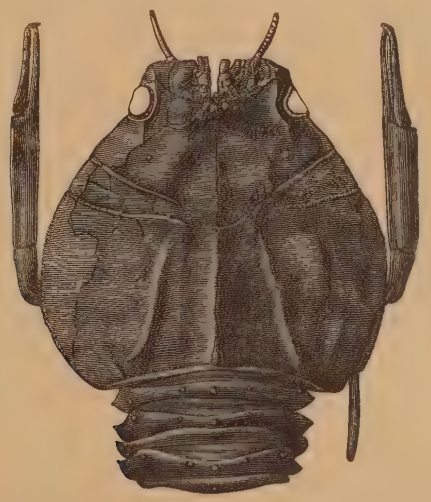

Fig. II.—*Eryon calvadosii*, after M. Morière. Reduced one-half.

recent seas, excepting that in the Calvados specimen large organs of vision are conspicuous, or rather, I should say, that the orbits for the reception of the organs of vision are well preserved, and as M. Morière says of his specimen that "On aperçoit des pedoncles oculaires." These are situated on the fronto-lateral margins of the carapace, on the outer side of the second pair of antennæ, somewhat after the manner occasionally seen in some of the Palinuridæ and some of the Scyllaridæ; but it is more common among the Brachyura than the Macrura. The eyes are similarly situated, but not so largely developed in the *Willemœsia* group, in which they are moreover in a more marked state of degradation. In *Willemœsia* and its congeners, the ophthalmopoda are deeply

[1] *Bull. Soc. Linnénne de Normandie*, sér. 3, tom. vii. p. 1, 10, pls. i., iii., 1883.

embedded in a fissure, varying in shape in different species, and are reduced in size and modified in form, the capacity of vision being confined to two small points, one on the upper or dorsal, and the other on the lower or frontal surface (Pl. XIII. fig. *a*), and in each it exists only to a limited extent, the organ being without the power of movement. Yet in the young, as may be assumed from the appearance of the embryo of *Willemœsia*. (Pl. XX. fig. 2), as observed previous to the escape of the brephalos from the ovum, the ophthalmopoda are globular in form, and distinctly pedunculated.

It is interesting to find in the same geological epoch some specimens of *Eryon* that are blind, and others with large and probably well-developed organs of vision. But it is not more remarkable than that living and adult specimens of *Cambarus* should be found with the ophthalmopoda in all stages of development, from the well-formed eyes of those that live in the waters of America that are open to the sun, to the blind forms dwelling in subterranean caves where light never penetrates. The loss of vision is not necessarily a disadvantage to a species, while its surroundings, both in relation to food and companionship with others necessary for its existence, are convenient, since sight is useless where there is no light and the absence of the organs of vision may lessen the risk to life while the conditions are permanent, but should these be withdrawn or vary, the want of sight must be detrimental in the struggle for existence and thus be a prelude to the extinction of a species.

The species of the Eryonidæ live at the bottom, where their food is abundant; for in the ancient as well as in the modern seas the myriads of organic forms constantly falling to the bottom from the extensive area of waters above in which they live, constitutes a continuous and unfailing supply of food that comes within their reach; and thus organs of vision are not necessary for the purpose of seeking food. Thus the Eryonidæ live and renew their species under conditions where other forms might perish.

I have previously remarked that the ophthalmopoda in the Eryonidæ are depreciated in character; but it should also be noticed that the departure in the recent genera takes place, as shown in Pl. XIII. *a*, in a direction that resembles that seen in *Benthesicymus* and *Gennadas* among the Dendrobranchiata (Pl. LVII. fig. 1*a*, and Pl. LIX. fig. 1). This is a point of considerable interest, since it is the only instance in which the secondary eye or ocellus is observable in the Trichobranchiata. In the division Dendrobranchiata the ophthalmopod is generally compressed, and the ophthalmus possesses a reniform shape, which in some species has the margin on the upper and inner surface projecting somewhat beyond its limit and forming an imperfect ocellus, or small secondary visual organs, so situated that it is capable of being useful as an organ of vision when the animal otherwise is at rest.

The ophthalmopoda in most of the species are projected at the extremities of a narrow transverse rod that probably represents the ophthalmic somite, and is sometimes

overlapped by a process from above and below, which covers it or encloses it within a groove, as has been previously described.

In *Aristeus semidentatus* the ophthalmus is hemispherical, and the peduncle suddenly narrows and tapers to the base. In *Penæus canaliculatus* the ophthalmopod is triarticulate and laterally compressed, the joints articulating with each other obliquely. It has rather a complicated appearance, having the ophthalmus situated obliquely at its extremity, the inner surface of which is flat, with a concave margin furnished with a small projecting pigmented process forming a connected imperfect ocellus near the middle of the arch (Fig. III.). In *Hepomadus glacialis* the ophthalmopod is pear-shaped and flattened; and at the angle formed between the cylindrical and compressed portions there is a small papilla. A similar but more important papilla

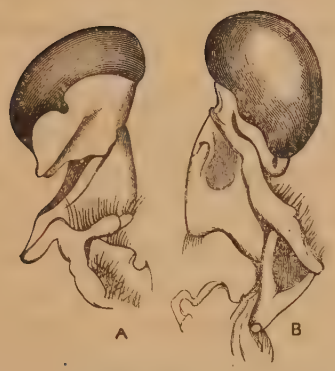

Fig. III.—*Penæus canaliculatus*. Ophthalmopod—A inner, B outer surface.

Fig. IV.—*Gennadas intermedius*. Ophthalmopod—*a'*, ophthalmus; *a''*, ocellus; *gn*, optic ganglion.

may be found in *Benthesicymus* and *Gennadas*, which culminates in some, if not in all species into a prominently pointed tubercle, as shown in Fig. IV., having a small circular lens at its extremity (Pl. LVII. fig. 3*a*; Pl. LVIII. fig. 1*a*), to which a distinct branch of the optic nerve, originating in a ganglion at the base within the ophthalmopod, may be distinctly traced. This secondary organ consists of a single lens, is very translucent, and has no trace of pigment. It appears to be present only in deep-sea specimens, but it is not confined to those of the Dendrobranchiate division, inasmuch as a similar protuberance may be seen in *Bentheocaris* (Pl. CXXIII. figs. 3*a*, 4*a*), and in *Hymenodora* (Pl. CXXXVII.) among the Phyllobranchiata. This circumstance has induced me to believe that this pedicular ocellus may be an altered condition of the sessile ocellus so common among the species of the latter division, and traces of which

may be found in some genera of the Dendrobranchiata. In support of this view, I think further evidence can be produced to show that different groups of animals, when placed under similar conditions, tend to resemble one another in certain points of form and structure.

In the Phyllobranchiata the ophthalmopoda are generally short and pear-shaped, and crowned by a hemispherical ophthalmus composed of well-formed and numerous lenses, radiating above a floor of black pigment. The margin is sharply defined as a straight line on the inner, anterior, and outer surfaces, but is hollowed or concave on the posterior side, and in this hollow there is almost invariably present a well-formed pigmented ocellus, sometimes detached (Pl. CXXVI. fig. 6), but more commonly more or less in contact with the margin of the ophthalmus, and sometimes so closely united with it that it can only be traced as a slightly elevated and circular body within the surrounding pigment of the ophthalmus (Pl. CXXVI.), but in this case the facets of the latter form a distinct system of their own, being generally of less size and corresponding in position to their smaller circumference. These have, moreover, a series of lenses that in character appear to resemble those of the ophthalmus, but they are smaller in size, shorter, and therefore proportionately stouter in comparison to their length; a circumstance that would necessarily give them a different extent of visual range.

The position of this organ is such that it can only be brought into use under certain conditions, namely, first, when the ophthalmopoda are erect the ophthalmus has a range of vision in front, above, below, and at the sides, but only partially behind, so that the animal is blind to any danger that may reach it in the line of its own dorsum; second, when the animal is at rest, with the ophthalmopoda lying ensconced in the hollow in the first joint of the first pair of antennæ, where it is frequently covered more or less perfectly by numerous hairs, the ocellus alone is in a position to enable a watch to be kept.

Mr. John Murray has suggested that these, like the ocelli found on the body and appendages of some Schizopods, are phosphorescent organs, and although I have adopted this explanation in the body of this Report, I am induced from examination of the structure and consideration of the position of the organs to believe that they are probably useful as organs of vision under the previously suggested conditions, as I find this structure differs from that of the ophthalmus only in degree and not in character.

Besides the two compound eyes there exists a small unpaired organ in the median line, which is one of the earliest structures to appear in the embryonic life of the Macrura. It appears as a patch of black pigment in the median line of the frontal neural mass, which ultimately becomes the anterior or optic ganglia of the group that form the cephalic mass, and out of which the future ophthalmi are developed. It also exists in most of the Copepoda and in the early stages of many if not all the Macrura. It may be seen in the later embryonic stages of most of the Macrura, but appears to be lost in the Zoea stage when the ophthalmi assume their functional power, but in those forms in which the

development is undergone within the ovum until the embryo has reached the Phyllosoma or Megalopa stage, it exists in the newly hatched animal. Whenever the two kinds are found together, the oculus is the first formed, and therefore, according to Professor Hartog,[1] who has given considerable attention to the development and structure of this organ, it must be regarded as the primitive eye of the Crustacea.

By investigating the anatomy of *Cyclops* and *Diaptomus* by the method of sections, he has ascertained that this organ is much more complicated in structure than was previously supposed. He says that Claus has demonstrated that it is formed in all cases of a central pigmented mass, in which are half immersed three lenticular bodies or crystalline spheres—two lateral and one central.

The pigmented mass is structureless; the colouring granules are situated at the surface contiguous to the crystalline spheres. Each sphere is composed of radiating elements or optical bacilli, the inner ends of which are applied against the pigmented mass, while the peripheral segments contain a nucleus.

He describes the oculus as being situated upon the terminal process of the brain, from which the optic nerves originate, one for each sphere; the nerve, instead of penetrating into the pigmented mass, surrounds the outer surface of the crystalline sphere and penetrates directly not far from its posterior margin.

Claus has figured an analogous structure in the unpaired eye in the Phyllopoda[2] but has not indicated its true significance.

Dr. Hartog concludes that the unpaired eye, in all Crustacea that possess it, is composed of three simple eyes placed anteriorly to the brain, with reversed optical bacilli, receiving conductive fibres of the optic nerve upon their outer margin, and brought so close together that these pigmented or choroid layers are combined into a single mass.

Dr. Hartog further says that the eye which most nearly approaches the unpaired eye in Crustacea seems to be that of the Planaria, and that according to Justus Carrière,[3] the structure of the two paired eyes in the Planaria is similar to that described by Dr. Hartog in the simple eyes united in the middle line of Crustacea. It is therefore, he says, more rational to refer the eyes of the Crustacea to such a primitive and ancestral group as the Turbellaria, than to seek direct approximation between higher groups.

It appears, therefore, that when the central eye is present in the embryo of the higher Macrura, as may be seen in that of *Crangon*, *Astacus*, *Palæmon*, and the Phyllosoma of the Palinuridæ (where it only exists as a deciduous organ, and disappears before the animal attains maturity), in most cases it is only represented by a mass of pigment and that the crystalline spheres are seldom developed. In Pl. XIIA. figs. 2, 4, a single sphere is shown in a specimen which was taken off Samboangan, in the Philippine

[1] De l'œil impair des Crustacés, *Comptes rendus*, t. xciv. pp. 1430–1432, 1882.

[2] Claus, Zur Kenntniss des Baues und der Entwickelung von Branchipus stagnalis und Apus cancriformis, *Abhandl. k. Gesellsch. Wiss. Göttingen*, 1873.

[3] *Archiv f. mikrosk. Anat.*, Bd. xx. p. 160.

Sea ; it represents the cephalic neural mass with the oculus or the unpaired eye, with one crystalline sphere in the median line ; but this I have failed to observe in the newly-hatched specimen as shown in fig. 1 on the same plate, which was obtained direct from the ovum.

It appears, therefore, that when present, as it is frequently in the Macrura until the animal is well advanced in development, it only exists as the remains of a worn-out organ that belonged to an earlier condition of life, and which only attains its true characters in those animals that produce the brephalos in the Nauplius stage. This unpaired organ appears therefore to be, as Dr. Hartog says, analogous to those existing in the lower forms of life, such as the Planaria, and perhaps also may be compared with those found in the mantle of *Pecten* and in the tissues of Annelids.

They are not in any way homologous with those eyes that in the Crustacea are projected on each side of the first somite of the cephalon, and in the Macrura are placed at the extremity of a two- or three-jointed appendage as may be seen in Fig. V. and also in Pl. XIV. fig. 2, in *Eretmocaris longicaulis* and other species on the same plate, in which the organ of vision is projected on an appendage of two or three articulations, so that in *Eretmocaris* it considerably resembles the appearance of an antenna that has the extremity modified for the purposes of vision, just as the antennæ on the homotypes of other limbs are modified for the purpose of touch, hearing, and smell.

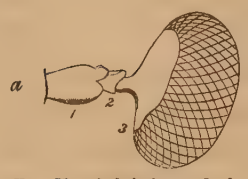

FIG. V.—Ophthalmopod of *Plesionika uniproducta.*

In *Eretmocaris* the ophthalmopoda, as well as the first, and perhaps the second antennæ, are attached to, and appear to originate in, a lobe that is anterior to and distinct from the carapace, and which also supports the central oculus.

The First Antennæ.—The first antennæ form the second pair of appendages, and belong to the second theoretical somite ; but this somite is seldom recognisable as a distinct part, except in the Squilliform Crustacea, and to a less extent, as well as in an aberrant condition, in the Palinuridæ.

The late Professor Milne-Edwards, as a convenient means of defining the first from the second pair of antennæ, gave to the anterior the name of antennules, which many authors have adopted, but which I have not employed in this Report, because the numerical system appears to be both more consistent and of greater value, and the term is suggestive also of diminutiveness or inferiority. Generally the first antennæ is proportionally smaller than the second, but usually it is a highly organised structure, and increases in functional power as it diminishes in length.

The peduncle consists of three joints which terminally support two long and slender flagella, the outer of which must be regarded as of more importance than the inner, for it carries certain organs that are apparently essential to the welfare of the

animal, since they are invariably present, and undergo modifications with sexual and specific variations; the inner, on the other hand, is of less importance, and seldom varies except in relation to length, in some forms being reduced to a minimum, or, as in *Lucifer*, it is wanting altogether.

Although in all Decapod Crustacea the first pair of antennæ consists of a peduncle and one or more flagella, yet the organ undergoes modifications in the different orders.

In the Trichobranchiata it may be considered as typical of the Macruran form, such variations as exist being common to the other divisions.

The most simple form exists in the Synaxidea, of which that in the Palinuridæ may be taken as the most normal. In these the peduncle consists of long narrow cylindrical joints, projected on an exposed portion of the antennal somite, and terminating in two slender flagella of nearly equal length. The first or basal joint is generally longer than the others, and increases in diameter towards the articulation with the somite; within this enlarged portion an acoustic organ exists, that undergoes modifications in the different genera. In *Palinurus*, *Homarus*, and *Astacus* the perforation is long, narrow, and slit-like, the aperture being scarcely appreciable, and opens into a calcified chamber, more or less filled with particles of sand, which are voluntarily placed in position by the animal soon after casting its exuvium,[1] and although the joints of the peduncle are cylindrical or nearly so in *Palinurus*, *Ibaccus*, *Homarus*, &c., yet in some genera of the Astacidea they undergo certain modifications, as, for instance, in those animals in which they are laterally compressed, the approximating sides being flattened against each other, and this is carried to such an extent in some genera of the Eryonidæ (as in *Willemœsia*), that the inner margins are pressed together, forced upwards, and thus form a vertical ridge in the median line.

The second and third joints of the peduncle are of little importance, and apparently only serve as carriers of the terminal flagella. In the ordinary or most simple form they are merely cylindrical joints, but in some species they are broad and short, having the distal angles produced to strong teeth.

Each of the two flagella arises from its own distinct base at the extremity of the third joint, one obliquely above the other, that on the outer and upper side being the more robust, and built up of a number of short rings or articuli, which are more or less abundantly furnished with protective hairs or spines, and amongst them are always a considerable number of flexible membranous tube-like cilia, that vary somewhat in form corresponding with other generic characters.

These membranous cilia were, I believe, first pointed out by myself in a memoir On the Homologies of the Carapace and on the Structure and Function of the Antennæ in Crustacea,[2] in which it is stated that the cilia "are always larger than ordinary hairs,

[1] This was first pointed out by Dr. Farre in 1843, *Phil. Trans.*, vol. cxxxiii. pp. 233–242.

[2] *Ann. and Mag. Nat. Hist.*, July 1855.

but more delicate in structure. These vary in number and in thickness of clusters, but, as far as my experience goes, are invariably present on the upper antennæ."

More extended research has led to these membranous cilia, or rods, being regarded as sensory organs, but their exact function has not yet been definitely determined. In some genera they are extremely numerous and they are usually more abundant in the males than in the females. By Leydig they have been regarded as having an olfactory function, but M. S. Jourdain[1] says that they are each covered by a delicate chitinous layer and divided into a variable number of joints; the free end has the form of a truncate cone and bears a hyaline process, which probably has a sensory function; within the sheath is a granular substance, derived apparently from the dermal layer, or chorion, and a nerve fibril has been traced to its base. These sensory rods are variously distributed in the different groups, but when the flagellum is branched they occur in one of the branches only. And thus they are almost invariably present in the Macrura, since the first antennæ are almost invariably biflagellate. Among the Edriophthalma, on the other hand, it is frequently uniramous; but even here the second branch is almost universally present in a rudimentary condition in the young, and the structure of the membranous cilia is essentially the same as in the other orders, but their arrangement shows an immense number of variations. M. Jourdain says that the first pair of antennæ has no special movements, and the number of rods is not great, but my own experience is at variance with these assertions, for the Amphipoda always while swimming carry the flagella of the first pair of antennæ elevated in the water, and slowly waving about as if watching for impressions, while in the Brachyura and Anomura, and in those Macrura where the flagella are short, they are kept in a constant state of vibration. But I agree with M. Jourdain in the belief that while admitting the function of these rods, or membranous cilia, to be sensory, there is nothing in their structure to prove them to be specially devoted to the sense of smell.

M. Robin, in a memoir on the subject,[2] after reviewing M. Jourdain's observations on the sensory rods, says that in all cases we find a very delicate chitinous sheath, which is penetrated by an offshoot from the hypodermic layer, and which at its base is found to be in relation to a branch of the antennary nerve; the free end is truncated and carries a hyaline body, which appears to be comparable to the rods found at the ends of sensory organs. These may be known as the "poils à batonnet." The hairs are cylindrical in some cases, and then the chitinous cylindrical sheath is made up of a number of joints; the basal ones have thicker walls, and are shorter than those which are more distal. In other cases the hairs are stipitate and then the joints are ordinarily reduced to three, and the basal one, which is of some length, is constricted in its middle.

A detailed study shows that the former arrangement is confined to the Podoph-

[1] *Comptes rendus*, tom. xci. pp. 1091–3, 1880.
[2] *Journ. Anat. et Phys.*, tom. xvii. pp. 402–418, 2 pls., 1881.

thalmous Crustacea; the hairs are found in the young, though in less numbers than in the adult, and similarly, they are more numerous in the higher than in the lower forms. Although there seems to be no doubt that these organs respond to stimuli which are something else than tactile, we are not yet in a position to definitely assert that they have an olfactory function. The author concludes by remarking that the character of these parts has a value for the systematist. That all parts have a value for the systematist is true, but I can find little that is trustworthy in the appearance of the membranous cilia, or sufficiently distinct and constant to assist in the determination of species. It has been shown that these membranous rods exhibit distinct variations of form in certain different species; but it is equally certain that a large number of very distinct species have them of precisely similar form, and they are therefore valueless as a guide for the determination of specific alliance, although in some instances their variation is distinct in closely allied forms.

In the genus *Palinurus* the flagella are very short and the outer one is robust (Fig. VI., *b'*) when compared with the inner. It commences with a long and narrow articulus at the base, obliquely attached to the peduncle; the second is shorter and a little broader, the next four or five are gradually broader but irregularly longer, after which they decrease much in length, especially on the outer side, so as to produce a curve in the flagellum; then the articuli gradually narrow towards the extremity, where they become slightly elongated. From the commencement of the shortening articuli to those at the distal extremity the inner surface is flattened (Fig. VI., *b''*), the margins of the depressions being furnished with a row of long, straight, stiff, sharp-pointed spines, those on the one side being ciliated, those on the other smooth, and between the two there is a thick mass of membranous cilia that are much shorter than the marginal spines. These membranous cilia have the walls of extreme tenuity, and parallel to a considerable extent, when they suddenly narrow to a long and slender point (Fig. VI., *b'''*); these organs when treated with caustic potash exhibit an articulate structure in the body of the cilium, but in the slender extremity a delicate spiral condition exists.

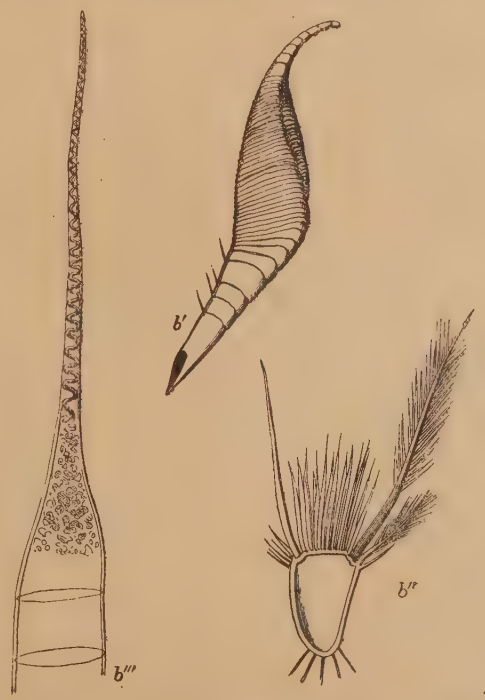

FIG. VI.—*Palinurus vulgaris*—*b'*, outer flagellum; *b''*, section of outer flagellum; *b'''*, distal extremity of a sensory cilium.

In the genus *Panulirus*, where the flagella (Fig. VII., *b'*) of the first pair of antennæ

are long and slender, the brush of cilia is much more extensive and is carried nearer the distal extremity than in *Palinurus*. In this genus the lateral spines (Fig. VII., *b''*) are smooth on each side and curl over to meet one another and protect the membranous cilia that lie between. In this genus these organs (Fig. VII., *b'''*) have parallel sides and terminate in a rounded extremity, the apex of which, as M. Robin says, carries a hyaline body.

Mr. G. L. Gulland[1] traces out what he considers the genealogy of these hairs in the Crustacea, starting with a primitive seta, allied to a fringing seta, but not so flattened. This ideal setæ stood over a wide canal; the lumen was closed, there was a single row of bristles on each side, and a nerve-ending attached to its base. Now these fringing setæ originated in one direction, and the sensory setæ originate in another; these were at first primary tactile setæ, which became modified in three directions, to give rise to auditory, olfactory, and tactile setæ. He does not in his paper discuss in detail the structure of the olfactory and auditory setæ, but restricts his observations to the consideration of the tactile and fringing setæ.

FIG. VII.—*Panulirus*. Antenna—*b'*, outer flagellum; *b''*, section of same; *b'''*, sensory cilium.

He furthermore remarks[2] that in addition to the sensory hairs "there is a ring of tactile setæ set rather far apart round the distal margin of each segment, the points of which are directed forwards; they are of the usual type, but very small, often not exceeding 0·1 mm. in length on the two or three most distal segments where the olfactory setæ are absent, the tactile setæ are longer and more numerous on the last segment." "On the third joint of the main stem there is one large group of tactile setæ on the outer margin at the base of the exopodite (outer flagellum),[3] and one or two isolated setæ near it; on the inner margin is a row of fringed setæ, and all the setæ on the first and second joints are also of this kind, with the exception of a very few small tactile ones in the inferior margin of the triangular first joint. If the antennule be examined *in situ* the significance of this arrangement will be at once apparent; for it will be seen that only those parts which bear tactile setæ

[1] *Proc. Roy. Phys. Soc. Edin.*, vol. ix. p. 159, 1885–86. [2] *Loc. cit.*, p. 160.

[3] This cannot be homologous with the exopodite since it springs from the third joint, whereas the exopodite (basecphysis) springs from the second or basisal joint.

are really external, and that these only could receive tactile impressions, since the other parts are covered by the eyes, the rostrum, squame of the antennæ, and the antennule of the opposite side. The fringing setæ along the margins of the surface which bears the opening of the auditory sac, as well as the close-set row of fringing setæ which cover the opening, act, doubtless, as strainers, and prevent the entrance of foreign bodies to that delicate organ."

Among the Dendrobranchiata the characteristic features of the first antennæ remain the same; that is, the peduncle consists of the same number of joints, and terminates in two slender flagella. But the first joint, instead of being cylindrical, is broad, flat, and deeply excavate on the upper surface for the reception of the ophthalmopod, which when at rest lies ensconced and protected by a fringe of hairs (the blepharis) that surrounds the excavation. In the genus *Sicyonia* the excavation is so deep that its floor becomes translucent. But whenever this is the case, the inner and outer margins become correspondingly thick and strong, the outer margin being armed with a long pointed process (stylocerite), often of considerable strength, and the inner margin with a long, slender, unjointed appendage, which I have named the prosartema, and which is confined to the genera of this division, and is not unfrequently reduced to a rudimentary and obsolete condition.

In *Penæus canaliculatus* the prosartema exists in the most perfectly developed form; it arises from the inner marginal wall near the base, and projecting forwards, overlies the ophthalmopod when the latter is at rest; the margins are fringed with hairs, and it reaches quite to the extremity of the first joint (Pl. XXXI. fig. *b*).

In *Penæus serratus* the prosartema is scarcely as long as in *Penæus canaliculatus*, the margins are fringed with hairs, and the stylocerite on the outer side is short and pointed.

In *Sicyonia carinata* (Pl. XLIII. fig. 3*b*) the prosartema is reduced to a rudimentary lobe thickly surmounted with hairs, and the stylocerite on the outer margin is long, slender, and pointed.

In the genus *Aristeus* the prosartema is little more than a rudimentary process fringed with hairs, and the stylocerite is produced to a length that passes beyond the distal extremity of the second joint of the peduncle.

Both these structures are useful for the protection of the ophthalmopod. The stylocerite does not exist in the Trichobranchiata, and only in a reduced condition in the genus *Sergestes;* while both it and the prosartema are absent in *Lucifer.*

In this division the second and third joints of the peduncle are shorter and stouter than the first; in many cases they assume a subcylindrical form, and they are occasionally armed by having the distal angles produced into teeth; but in all essential points these two joints are only of importance as being the supporters of the two flagella. In the genus *Penæus* the flagella are never extremely long, and are sometimes

very short, as in *Penæus canaliculatus*, where they are subequal in length and but little longer than the terminal joint of the peduncle; one is cylindrical and the other is flattened, and has the margins on the lower surface projecting above the middle portion. In *Aristeus* the flagella are very unequal in length, and very distinct in their cross-section, the inner being cylindrical, slender, and longer than the animal, while the outer is short and flat, with the margins thickened on the lower surface. In *Solenocera* the flagella are subequally long and have their margins parallel, one flagellum being cylindrical and the other longitudinally concave, and both truncate at their extremity; the cylindrical is the smaller, and when at rest lies in the hollow of the other in its entire length.

In *Haliporus* the flagella differ in the larger being flattened, but not fluted, and both terminate in gradually tapering extremities.

In *Sergestes* the secondary or inner flagellum is reduced to a small, almost rudimentary condition, as shown in Pl. LXXI. fig. *b*; but in the male another branch is given off, which is developed somewhat like a claw or retaining hook, varying in shape in different species. As this is only present in the male, it must be of value in its relation to sex, and must be of more importance than its simple character would seem to suggest.

According to my observation, in the specimens of this collection the membranous cilia, or sensory rods, are less numerous and less important among the Dendrobranchiata than in the other divisions.

In the Phyllobranchiata the first pair of antennæ is developed upon the same general plan as in the two preceding divisions; but it is flattened out and cupped to receive the ophthalmopoda. The prosartema is never present, but on the outer side the stylocerite is developed into a large, flattened plate, generally sharp-pointed, but sometimes, as in *Pandalus*, rounded instead of being styliform.

The acoustic apparatus in Crustacea has been extensively studied. Dr. von Hensen, in his memoir on the subject,[1] has described it in twenty-eight species, but that is a small number compared with those that have not been examined. The direction of the research appears to show that in the Trichobranchiata particles of sand take the place of otoliths, whereas in the Dendrobranchiata and Phyllobranchiata the latter are more constant, and certainly in a higher degree of development, as may be seen in the genera *Tozeuma* and *Anchistia*, in both of which the otolith is as well formed as in any of the Schizopoda or Sergestidæ.

Among the Macrura generally the first pair of antennæ terminates in two flagella, and, so far as my experience enables me to say, *Lucifer* is the only genus in which it terminates in a single flagellum (Pl. LXXIX. fig. 1*b*).

The outer flagellum supports a number of membranous organs, which are generally massed together at the base, and are more abundant in the male than in the female; the

[1] *Zeitschr. f. wiss. Zool.*, Bd. xiii., 1863, pp. 319–412 (p. 18 sep. copy).

inner branch, on the other hand, is entirely free from these sensory appendages, and is generally smooth, slender, and flexible; it varies in length, being frequently much longer than the outer flagellum, and in other species it is considerably shorter. The constant presence of an organ of such simple character indicates that it fulfils some permanent function, which, I believe, consists in protecting and keeping clean the mass of membranous cilia attached to the outer flagellum. This idea receives support from a consideration of the relative positions of the two flagella, and from the fact that in *Pandalus modestus*, as may be seen in Pl. CXIV. fig. 4*b*, the inner flagellum has a tendency to curl spirally around the outer; when the flagella are long the membranous cilia are less aggregated, extending sometimes to the very extremity.

In the genera *Palæmon*, *Bithynis*, *Lysmata*, and *Alpheus*, the outer or primary flagellum divides at a greater or less distance from its base into two branches of varying length, the basal part of which carries the sensory organs, while the other part is slender and unadorned.

According to Mr. Gulland, on the inner or secondary flagellum "the arrangement of the tactile setæ is the same, but there they are rather longer."[1]

The Second Antennæ.—The third pair of appendages consists of the second antennæ. These are often very large and powerful organs, frequently adapted for weapons of offence. Each consists of two distinct portions, the peduncle and the flagellum. The peduncle has five joints in all the Macrura excepting the Synaxidea, in which there are only four, and the flagellum is composed of a series of short articuli which together form a long and slender flexible rod, generally gradually tapering from base to apex.

The most simple and characteristic form of the second antennæ is to be seen in the Palinuridæ, in which family also some of the most interesting and peculiar features in the antennæ of Crustacea are exemplified.

In *Palinurus*, the first or coxal joint is fused more or less perfectly with the somite to which it belongs, and with the ventral surface of the fourth mandibular somite. The under surface alone of the coxal joint is calcified, and near its posterior margin stands the phymacerite, a prominent tubercle, at the extremity of which is an opening closed by a very thin chitinous membrane.

This passage is in connection with the organ known as the green gland, which in this family is largely developed and is lodged both within the coxal joint and posterior to it within the cephalon. The function or nature of this organ has not been satisfactorily determined, but its anatomy has received the attention of naturalists, chiefly in the case of the Entomostracous Crustacea and the Amphipoda, and especially by Dr. Carl Grobben in a memoir on The Antennal Gland of the Crustacea.[2] According to this author the antennal gland is a renal organ with a saccular appendage and urinary passage. The

[1] *Loc. cit.*, p. 161.

[2] *Arb. Zool. Inst. Wien*, Bd. iii. Heft 1, p. 18, 1880.

urinary canal he considers as a long convoluted tube, which opens on the calcified projection or phymacerite.

Professor Huxley says in his work on the Crayfish[1] that—"The existence of guanin in the green gland rests on the authority of Will and Gorup-Besaniz,[2] who say that in this organ and in the organ of Bojanus of the fresh-water mussel, they found 'a substance the reactions of which with the greatest probability indicate guanin,' but that they had been unable to obtain sufficient material to give decisive results."

In a memoir read before the Royal Society, Dr. A. B. Griffiths gave an account of his chemical researches on the green glands of *Astacus fluviatilis*, in which he states that it is a true urinary organ, and that its secretion contains uric acid and very small traces of the base of guanin.[3]

More recently Herr Rawitz has given an account of his researches on the green gland of the Crayfish[4] (*Astacus fluviatilis*). After giving an account of the researches of Leydig, Wassiliew, Grobben, and others, he describes the gland, which, like Huxley, he compares in shape to the fruit of the mallow, as consisting of three different substances, green, white, and yellowish-brown. The green structure appears to be the outer shell or skin, within which the two others are enclosed. It consists of homogeneous cells, with a delicate contour, containing a well-defined nucleus, and a few clear green pigment granules which have a tendency to collect and escape at one pole. The white substance is characterised by the absence of all pigment and by the shining appearance of the epithelium. The yellowish-brown substance owes its colour, not as Grobben says, to a disposition of irregular bodies of a yellowish-brown colour in the protoplasm, but to the presence of more or less intensely straw-coloured nuclei.

The products of secretion found in the white portion are round dull globules with a sharp contour line and of a transparent homogeneous appearance.

From a study of the general structure Herr Rawitz has arrived at the conclusion that the green gland consists not of a single much-coiled tube, but of two which unite just before the entrance to the sac; of these the longer tube forms the green and the mass of the white substance, while the second forms the yellowish-brown substance and a small portion of the white. There is never any direct communication between the green and the yellowish-brown substances. As to function, the author thinks that as yet, in the absence of a more complete physiological investigation, it is premature to conclude that the antennal gland of the Crayfish possesses the functions of a kidney.

On the outer side of this joint in *Palinurus* an involuted fold exists in the hard wall so as to form a fulcrum on which a process of the second joint rotates. Generally there

[1] P. 353.
[2] *Gelehrte Anzeigen d. k. Baierischen Akademie*, No. 233, 1848.
[3] *Proc. Roy. Soc.*, pl. xxxviii. p. 187, 1885.
[4] *Archiv f. mikrosk. Anat.*, Bd. xxix. p. 471, Taf. xxviii., xxix., 1887.

is one also on the inner side, but it is wanting in this genus on the first or coxal joint.

The second joint or basis, the basocerite of Milne-Edwards, has on the outer and lower angle a double-lobed calcified process corresponding with one developed on the first or coxal joint, and which rotates against it, by the single lobe of the latter, which is formed by a simple convolution of the hard wall, falling between the double lobe of the basisal joint. On the inner side of the basisal joint the articulating process is also developed, but there is no corresponding one on the coxa with which it can articulate. Probably this is primarily due to the fact of the large projection of the sternal portion of the first antennal somite precluding calcareous development in the inner walls of the coxal joint of the second pair of antennæ. The inner articulating process of the basisal joint having no point of attachment has a free motion, and being pressed upwards, rests upon the anterior portion of the projected sternum of the first antennal somite; the attaching membranous tissue is consequently largely developed and overlies it also. On the inner surface of this membranous fold, between it and the sternal portion of the first

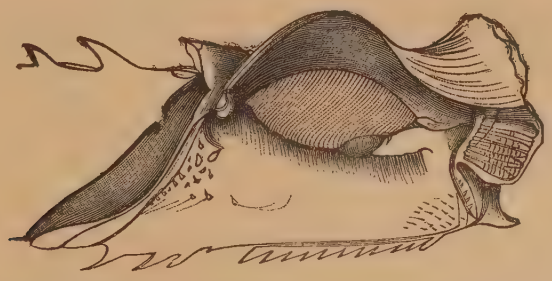

Fig. VIII.—*Palinurus vulgaris.* Basisal joint of second antenna, showing stridulating organ.

antennal somite, just where it joins the concave surface of the hard wall of the antennæ, two small chitinous plates are developed; one is comparatively large, ovate, and obliquely striated with regularly corresponding lines, it is elastic in structure and opaline in appearance; the other is small, ovate, with a smooth surface, and amber coloured; below these, planted in a furrow, there is a line of thickly-set hairs. These structures form the stridulating organ (Pl. Xa. fig. *c*), and the joint instead of being articulated at both extremities with the preceding as is usual in other forms, has the inner surface free and capable of being played forwards and backwards over the smooth wall of the first antennal somite, thus producing a sound that may be heard at a distance, even when produced artificially after death.

The fact that the common rock-lobster possesses the power of making a sound by means of the antennæ has long been known to our fishermen. It was mentioned by Dr. Leach in his Malacostraca Podophthalma Britannica, but the sound-producing structure was first described by Dr. Karl Möbius in 1867.[1] More recently it has been

[1] *Archiv f. Naturgesch.*, Jahrg. xxxiii. p. 73, 1867.

described and figured by Professor T. J. Parker,[1] who says that Mr. Saville Kent remarked in Nature[2] upon the shrill squeaking sound emitted by living specimens of *Palinurus vulgaris* when handled, this sound being due, according to Mr. Kent, to the friction of the abdominal somites; and Mr. Parker suggested that the noise referred to may possibly have been produced by the apparatus described.

Dr. Möbius attributes the sound made to the action of innumerable close-set minute hairs inclined with their points upwards, situated on the lower surface of the flap, which plays over the lateral ridge of the antennular sternum; but with regard to the statement that it is the friction of the flap, and not of the pad, which produces the sound, Mr Parker[3] says that he has "removed the flap entirely without any sensible diminution of the noise. The mere observation of the parts while in action is enough to show the true state of things: when looked at from the front it is very evident that the flap exerts hardly any pressure upon the ridge, as, indeed, from the fact that it is a soft structure supported only along one edge, it could scarcely be expected to; while the pad, on the other hand, is completely flattened out against the smooth surface, and in the most perfect contact with it." Mr. Parker also remarks:—"In the matter of histiological structure, the pad does not differ from other chitinous membranes, being formed of fine superposed horizontal laminæ, marked by a vertical striation. It is, however, of unusual thickness; and its horizontal laminæ have, for some distance down, a varying appearance, corresponding with the ridges into which the surface is raised. The stridulation is almost equally audible in water and air." I have produced it with specimens taken out of spirits, but it soon wore off. Dr. Möbius and Mr. Lloyd heard it in the Hamburg Aquarium; and Mr. Parker observed the sound and the movement of the antennæ producing it in a specimen brought alive to the Biological Laboratory of the School of Mines.

A similarly formed stridulating organ exists in the genus *Panulirus*, but in the closely allied genus *Palinosytus* the inner articulating process is attached, and works as a movable hinge, and there is consequently no stridulating organ; nor is there any in the genus *Synaxes*.

This second joint of the peduncle is peculiar throughout the whole of the Macrura, in having attached to it an articulating appendage, the scaphocerite, excepting in the tribe Synaxidea, and in the genus *Nephropsis* among the Homaridæ. In the family Scyllaridæ, the first joint is fused with the cephalon and the third is peculiarly produced on the outer side to form an elongated plate; the fifth, which represents the flagellum, is produced in this family in the form of a large, broad, thin, disc-like plate.

In the Astacidæ, of which *Homarus* is the most perfect type, the scaphocerite exists probably in its most normal condition, and has a rigid external margin produced to a

[1] *Proc. Zool. Soc. Lond.*, pp. 298, 442, 1878.
[2] *Nature*, November 1877.
[3] *Loc. cit.*, p. 443.

sharp point, and the inner side flattened out to a thin foliaceous plate, broad at the base and gradually narrowing to its extremity, or to near the apex of the outer margin which is generally separated from it as a free process.

It is, however, amongst the Dendrobranchiata that this appendage is seen in its fullest development. In *Penæus*, *Aristeus*, &c., it is large and broad, with a small tooth on the outer margin. In *Benthesicymus* and other deep-sea forms it is broad and of extreme tenuity, having only the feeblest representation of the external marginal tooth. In *Sicyonia*, on the contrary, the outer margin is intensified to a strong and powerful sharp-pointed spine, and the inner foliaceous plate is reduced considerably in size and thickness.

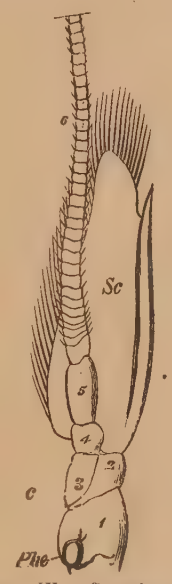

Fig. IX. — Second antenna. *Phe*, phymacerite; 1, 2, 3, 4, 5, joints of peduncle; *Sc*, scaphocerite; 6, flagellum.

In the Phyllobranchiata the scaphocerite is longer than in the Trichobranchiata, but not so broad generally as in the Dendrobranchiata. In some genera, as *Oplophorus*, it is produced to a sharp point by the strengthening of the outer margin and the reduction of the foliaceous plate of the inner side.

If we judge of the utility of the scaphocerite by its structure, there can be little doubt that when developed as a large foliaceous plate it is of much value in helping to maintain the animal upright when swimming, preventing it from falling into an inverted position as seen in the Amphipoda and other Crustacea, where it does not exist or is only feebly represented, as in some of the Astacidea.

When it is produced to a sharp point, as in *Sicyonia* (Pl. XLIII. fig. 3*c*″), *Oplophorus* (Pl. CXXVII. fig. *c*), *Acanthephyra* (Pl. CXXV. fig. 1*c*), *Thalassocaris* (Pl. CXVII. fig. 1*c*), &c., it is evidently used as a weapon of offence. In these genera the teeth affixed to the outer extremity of the second joint of the peduncle, which are generally of little importance, are developed to a greater extent, and fulfil an important office by guiding the scaphocerite into a corresponding groove, where they support it. In some instances, as in *Sicyonia*, they lock it into a fixed position, and thus increase its power as a weapon of offence. In the Astacidæ, where it is sharp-pointed and strong, it is too short to be useful as an offensive weapon, and probably is of value only in protecting the sensory organs.

In *Hemipenæus* the scaphocerite is very large and broad, and the outer distal tooth is small; and in some specimens the distal margin is considerably thickened, and the hairs are wanting; this condition appears rather to be the result of some exceptional state than a normal condition (*vide* p. 304). I am inclined to believe that this organ may be used for such a purpose as that of disturbing the muddy bottom over which it lives, with the object of procuring food, and that the constant gentle friction so produced would first remove the marginal hairs, and then induce such irritation as to cause this

thickened condition of the margin. Both the specimens in which this condition has been observed are males. It is not impossible that it may have been produced by rubbing against objects during pursuit of the female, but in this case we should expect some similar condition in other genera, and I know of none.

I have recently had the opportunity of seeing the extensive and well-preserved series of specimens collected by Professor A. Milne-Edwards during the voyage of the "Talisman,"[1] among which he drew my attention to a species of *Aristeus*, in which the scaphocerite of all the adult males had the foliaceous extremity produced in length to a considerable degree (Fig. X.). It would seem as if this condition might be valuable as not interfering with the speed of the male when in chase of the female, and perhaps of grasping her when caught.

FIG. X.—*Aristeus coralinus*, A. Milne-Edwards. Scaphocerite.

Figure c on Pl. L. shows the scaphocerite previous to its having undergone much change; but a slight emargination, which is not a constant feature, demonstrates the area in which the abnormal thickening takes place in older male specimens.

In some of the younger stages, such as may be seen in those of *Sergestes* (*Elaphocaris crassus*, Pl. LXI. fig. 4*c*; *Platysaccus crenatus*, Pl. LXIII.; and *Elaphocaris*, pp. 354, 359), and in the Zoea of *Alpheus* (Pl. LXXXIX. fig. 4*e*), the scaphocerite exists as a cylindrical multiarticulate appendage, fringed with ciliated hairs attached to each articulus on one side only, which demonstrates its homotypical relation with the basecphysis of the percionic and pleonic appendages. From this condition it gradually passes into the uniarticulate squamose plate of the normal scaphocerite, the only exception being in the genus *Atya*, in which a diæresis crosses the middle of the scaphocerite (Pl. CXVI.).

The third joint of the peduncle in all Macrura articulates with the second by two corresponding tubercles, one on the inner, and one on the outer margin; the inner being considerably the more advanced, gives the articulation an oblique direction.

The fourth joint articulates with the third by similar processes on the upper and lower margins; and the fifth joint articulates with the fourth by processes on the inner and outer sides. Thus the peduncle is capable of being moved in every direction by the powerful muscles situated at the base, the range of movement being considerably increased by the alternating articulations, and the correspondingly alternate positions of the muscles of each succeeding joint.

The fifth joint is generally short, constantly anchylosed with the fourth, or so rigidly

[1] I cannot here pass over the opportunity of acknowledging the great courtesy of Professor A. Milne-Edwards in sending over to me at Plymouth the beautiful specimen in order that I might have the opportunity of making the drawing from which the above figure was taken.

attached as not to be independent of it; in many it is fused with it and cannot be demonstrated as distinct. This is the case for instance in *Sergestes*. One thing, however, is invariably constant, that however few the joints of the peduncle may appear, that which supports the scaphocerite is always the second.

At the extremity of the peduncle a flagellum is attached which is generally long and slender; its length varies from half to three or four times that of the animal. Sometimes it is short, and in the Scyllaridæ it is squamose and discoidal, and in the fossil form *Cancrinos claviger*, Münster, from the Upper White Jura of Bavaria, it is short, robust, and club-shaped; but this reduction of length is generally due to the shortness of each articulus. The margins are occasionally armed with a series of more or less important spines, so that in the Palinuridæ these organs become effective as a means of protection. As a rule, however, they are smooth and free from hairs or spines, and by their great length sweep the water in search of objects, the character of which they seem to appreciate by the sense of touch.

In the genus *Crangon* they are used to assist in concealing the animal beneath the bottom, by playing over the dorsal surface, and drawing particles of sand over the back so that it becomes covered from view.

In *Palinurus* they are strong and rigid, being capable of use as weapons of offence or defence.

The Mandibles.—The mandibles are the appendages attached to the fourth somite, and consist of a large angular joint supporting two or three other joints of rudimentary character, that vary in number and form according to generic distinction.

The joint of which the mandible proper consists is the homotype of the coxa of the crustacean leg, differentiated to fulfil certain specialised functions; and it possesses very similar characters throughout the whole of the higher orders. It is deeply implanted in the body of the animal by a thin broad process of a concavo-convex form (apophysis), the muscles of which are inserted by strong calcified tendons on the inner anterior margin and at the extremity of the apophysis, the other extremity of the muscles being attached, either to the dorsal surface of the carapace or else to its lateral wall just behind the hepatic tooth. At the points of the mandible opposite to those where the tendons are attached two hinges exist, on which the appendage swings in performing the action of opening and shutting.

The anterior or distal extremity of the joint is modified to form a grasping or cutting portion and a grinding process; the former is broad, thin, and of a more or less concavo-convex form, while the latter is stout, cylindrical, and truncate, the truncate extremity being furnished with numerous small teeth and spines of variable form and power. For the sake of clearness of description, I have in this Report named the grasping or cutting portion the psalistoma, on account of its scissor-like mode of

meeting its opponent; and the grinding portion the molar process, on account of its chewing function. At the base of this process, where it is connected with the psalistoma, there originates a small articulated appendage, which I have designated the synaphipod, because I believe it to be formed of those joints that morphologically represent the distal continuation of the crustacean limb. This part is frequently known as the palpus of the mandible, a term that implies an unknown portion of the appendage. This term is also frequently applied to that part which I describe as the ecphysis, a branch of the basis or second joint of the crustacean leg, and it is clear that they cannot be either homotypical or homological parts, since they proceed, one from the coxa, the other from the basis of the typical leg. Furthermore, this appendage, like all true or permanent parts, is not developed in the early or immature stages; whereas the basecphyses or appendages of the second joint are always developed first, and in many families, particularly among the Trichobranchiata, they only exist as deciduous organs, being thrown off in the later moults of the mature animal.

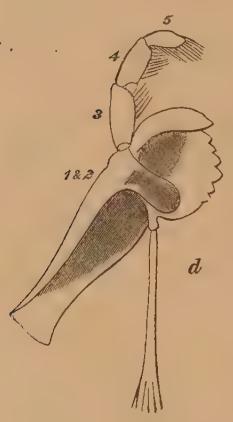

FIG. XI.—Mandible.

In some species of the higher forms of the Entomostraca, such as *Pontella*, *Notodelphys*, and *Doropyges*, the two appendages are both present in the same animal, but this may also be observed in an immature condition in some species of the higher groups. It is not developed at all until the animal approaches its adult state, and in some genera it never makes its appearance, while in others it is only in an enfeebled and rudimentary condition. When in its most characteristic form, it lies, when at rest, folded within the hollow formed by the closing of the two scissor-like blades of the mandibles, and when in action it is apparently used as a means of assisting to carry the food into its position between the molar processes, and perhaps also, particularly in those species in which they are thickly covered with hair, of being used for the purpose of keeping the parts within its reach clear, or free from undesirable material.

This part of the mandible varies in the number of its joints; there are never more than three, frequently less, and sometimes, as has been said, it is absent altogether.

Throughout the Astacidea the synaphipod is almost invariably composed of three joints, the exceptions being the genus *Arctus* and the Eryonidæ, in the former of which it has only one, and in the latter two joints.

In the Dendrobranchiata it is generally very long and well developed, but consists, I believe invariably, of two joints only; and in those species in this division in which, in this Report, the mandible is figured without a synaphipod, it is probably because the specimen is an immature animal.

In the Phyllobranchiata there is a greater degree of variation, and this appears to lie, so far as my observation goes, in the presence of a three-, two-, or one-jointed synaphipod,

or in its absence altogether, even in the adult stage; in every case where it is present it is reduced in size or rudimentary.

In *Palæmon*, *Pandalus*, *Nauticaris*, and *Heterocarpus* it is three-jointed; in *Paralpheus* it is one-jointed; in *Alpheus*, *Synalpheus*, and *Spirontocaris* it is two-jointed; in *Hippolyte* it is wanting, as it is also in *Crangon*, *Nika*, *Gnathoptylus*, *Lysmata*, *Pontonia*, *Atya*, *Caridina*, *Ephyra?* (de Haan *not* Roux), and *Pasiphæa*.

The psalistoma is very variable in form in different species or genera. In its most characteristic form it appears as a large concavo-convex blade, with a more or less serrate margin which is generally rounded. In some genera the shape of this part is modified; in others it is diminished more or less conspicuously in size; while in others it disappears altogether. The greatest variation exists perhaps in the Phyllobranchiata, and it is rarely present when the synaphipod is absent. The molar process, on the other hand, exists, I believe, universally throughout the higher Crustacea, as a well-developed organ, and it may be seen in the genus *Crangon* and some near allies without connection with the psalistoma or synaphipod, which generally form parts of the normal mandibles of the Macrura (Pl. LXXXVI. fig. 1*d*).

In *Crangon* and most of the Phyllobranchiata the mandibles are deeply inserted within the oral aperture, whereas in the Trichobranchiata, more especially in the Palinuridæ, they are placed at the entrance of the oral tract so superficially that the outer surface of the apophysis is exposed and frequently matted with short hairs.

Fig. XII.—First Siagnopod.

The First Siagnopoda.—The first pair of siagnopoda, frequently known as the first pair of maxillæ, is perhaps amongst the most unchanging of the appendages. It consists generally of three branches, which are always small and of great tenuity; two of the branches are directed inwards, these are broad and spoon-shaped, and have the inner margins fringed with hairs, more or less densely packed, these hairs often increase in strength without gaining in length, assuming a smooth and spine-like condition. The third branch is very thin, and is the one which varies most in form, but only within narrow limits; sometimes it is two-jointed, never more; it is always directed outwards, and is seldom furnished with more than one or two hairs, which, however, are frequently long.

Among the Scyllaridæ the first siagnopod has never more than two branches, and these correspond to one another and are directed inwards, both being tipped with short spines or hairs.

This pair of appendages lies close against the mandibles, hugging them on the outer side of the metastomata; and they appear to be useful in preventing the escape of food from the lateral angles of the mouth, and to be of little use for any other purpose.

It is almost impossible to determine the homotypical relation of the several joints in comparison with those of the true Crustacean leg, but it appears to me that the two inner branches belong to the coxa and basis, and that the external branch is an ecphysis of the second joint.

These five pairs of appendages belong to the great dorsal shield, and are the true cephalic appendages, the following pairs belonging to the pereion.

The Second Siagnopoda.—The second pair of siagnopoda is large, variable in form, situated on the outer side of the first pair, but a little behind it, and planted at the anterior exit of the branchial chamber. It generally consists of three or four branches, two of which are short, broad, and foliaceous, while the third is cylindrical and rod-like, and one is long, broad, and membranous.

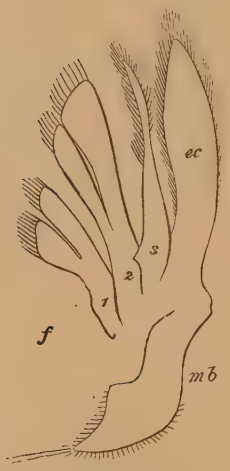

FIG. XIII.—Second Siagnopod.

The first joint is generally broad and short, the inner margin being thickly fringed with ciliated hairs; this joint I take to be the homologue of the coxa of the theoretical leg. The second joint frequently resembles the first in form and general appearance and is similarly furnished with hairs, but it is usually bilobed, and the marginal hairs are simple; the third branch is short and cylindrical, and tipped with one or two hairs; on the outer side is the broad and membranous plate that I take to be the homotype of the mastigobranchial plate of the pereiopoda; it is liable to vary in form and size, but that belonging to *Spirontocaris spinus* is illustrative of the most normal type (Pl. CVII. fig. *f*).

In *Homarus* this pair of appendages consists of three branches or joints, of which the two inner are double and foliaceous, the outer being single and tapering. In *Astacus* the same conditions exist, but there is added on the outer side a broad and leaf-like plate of semi-membranous character, and this I believe is the homotype of the mastigobranchia attached to the pereionic appendages.

In *Stenopus* and *Spongicola* this appendage is formed on the same plan, but in these two genera the outer plate or mastigobranchia is produced posteriorly as well as anteriorly, but is ciliated most abundantly on the anterior margin.

Passing on to the Dendrobranchiata we find this latter condition continued, but the anterior branches are shorter and broader, as in *Penæus*, *Sergestes*, and *Sicyonia;* the first and third branches having a tendency to become rudimentary.

In the Phyllobranchiata the same structure exists, but with a greater variation of parts. The first joint generally carries the branch on the inner side, although as in *Athanas* and *Alpheus* it may be seen only in a rudimentary condition; the second joint is bifid as among the Trichobranchiata, but differs somewhat in form, being deeply

cleft in *Palæmon*, broad and scarcely cleft in *Alpheus*, *Pandalus*, and unbranched in *Crangon*, *Gnathophylum*, and *Nika*, in which genera the third branch exists as a single obtusely pointed process, and on the outer side the mastigobranchial plate projects posteriorly, sometimes in a broad and leaf-like form, and sometimes as a long and narrow process; it is generally fringed with a series of long hairs that appear to have the power of sweeping the branchial chamber to the most distant limits.

The Third Siagnopoda.—The third pair of siagnopoda, or maxilliped, as we see it in *Homarus*, is composed of four joints, of which the first has no branch; the second consists of a broad and foliaceous plate having the inner margins fringed with cilia; the third is long and narrow, with a tendency to break up into joints, and beyond this there is a long two-jointed branch, the distal joint being multiarticulate. In the freshwater genus *Astacus* the structure is very similar, but the first joint is produced to a short and rudimentary plate fringed with cilia on the inner margin.

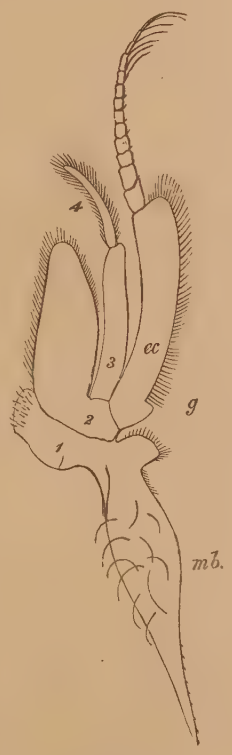

Fig. XIV.—Third Siagnopod.

In *Palinurus* the two inner joints are more reduced; the third is short, rudimentary and single-jointed, and the fourth consists of two long slender joints, of which the second is multiarticulate; on the outer margin beyond this joint is an appendage that is rudimentary in *Palinurus vulgaris*, two-jointed in *Palinosytus lalandii*, and in *Palinurus* (?) *japonicus*, where it is sufficiently developed to demonstrate its relationship to the mastigobranchial plates of the pereiopoda.

In the genus *Hetairus* (Pl. CIX. fig. 2*g*) it is developed so that the true nature of the several parts can be demonstrated. The first joint is broad and foliaceous, and on the posterior margin supports a large plate, divided by an opaque line across the middle dividing it into two parts, suggestive of one being the elementary stage of a branchial plume, the other of a mastigobranchial plate. The next joint supports a long filamentary branch and resembles a basecphysis of the pereiopod, differing from it in having a large foliaceous plate developed at its base; beyond are two cylindrical joints forming the continuation of the true limb.

In *Plesionika* (Pl. CXIII. fig. 1*g*) the morphology is still more clearly advanced, and shows the double-lobed mastigobranchia divided into two distinct foliaceous plates, connected at the base, just as may be seen in Pl. XIIb. fig. 4*g*; in *Phyllosoma* the branchial plume exists as two simple sacs, but within one the branchia is forming, while the other retains the simple features of the mastigobranchia.

In some genera, such as *Thaumastocheles* (Pl. VII. fig. 1*g*), *Willemœsia* (Pl. XVIII. fig. *g*), *Pentacheles* (Fig. 21, p. 107), and *Polycheles* (Fig. 32, p. 125), what I take to be the basecphysis is developed at the extremity in the form of a freely movable leaf-like plate, which probably quivers under the action of the expiratory current from the branchial chamber.

In *Pasiphæa* a similar condition also exists, but in a more rudimentary state, as shown on Pl. CXLI. fig. 1*g*.

The First Gnathopoda.—The first pair of gnathopoda assumes a more leg-like character than either of the preceding appendages, but it is not entirely pediform until we come to the aberrant Schizopoda, and the still more distant Amphipoda.

It is generally formed of five joints, but in some genera there are six, and in a few, as in *Nephrops thomsoni* (Pl. XXVI. *h*), there are seven joints. In general character it is usually short, wide and thin, the three distal joints being reflexed on the inner side, and the dactylos is generally broad and flat. The larger the number of joints the narrower they are, and the more pediform is the whole appendage; but when the joints lessen in number, the reduction is made by the coalescence of the meros and ischium, and sometimes the basis also, into one, and by the absorption or loss of the dactylos. Attached to the basis is an ecphysis that is generally long and two-jointed, the distal joint being multiarticulate; sometimes it is only single-jointed, as in *Oplophorus* (Pl. CXXVII. fig. 1*h*) and in *Nephrops*, where it puts on a somewhat rudimentary appearance. I do not remember an instance in which it is altogether absent, unless it be so in *Pasiphæa* (Pl. CXLI. fig. *h*). The coxa almost universally has a mastigobranchial plate attached, which is generally of small size and varies in form, and has very constantly a branchial plume attached to it, and occasionally a second or arthrobranchial plume attached to the membranous articulation.

In the Astacidæ branchial filaments are attached to the outer surface of a large membranous plate that appears to resemble the mastigobranchia.

The Second Gnathopoda.—The second pair of gnathopoda is more perfectly pediform than the first, but varies to a greater extent in the number of its joints. In the Trichobranchiata it consists of seven joints, in, I believe, every genus, not excluding the Stenopidæ. This circumstance is the more remarkable in the Palinuridæ and the Scyllaridæ, as in these two families all the pereiopoda have only six joints each.

In the Dendrobranchiata there are also seven joints; and as the leg becomes longer and more slender in its gradual passage from *Penæus*, through *Haliporus*, *Sergestes*, and *Lucifer*, it assumes more closely the character of the succeeding simple legs.

In the Phyllobranchiata the number of joints is generally limited to five, this diminu-

tion being due to the coalescence of the meros and ischium into one, and the absence of the dactylos.

In *Glyphocrangon* (Pl. XCII. fig. *i*), *Spirontocaris* (Pl. CVII. fig. *i*), and *Nauticaris* (Pl. CVIII. fig. *i*) there appear to be only four joints, a fact that is due to the fusion of the basis with the ischium and meros.

The coxa of this appendage I believe invariably supports a small and rudimentary mastigobranchia, but it only in certain forms carries a podobranchial plume which is attached to this pair of gnathopoda in all the Trichobranchiata, excepting the family Eryonidæ.

In the Dendrobranchiata it is absent in *Penæus* and its nearer congeners, but it is present in the deep-sea forms, such as *Aristeus*, *Benthesicymus*, and its near allies; and it is rudimentary in *Haliporus*.

In the Phyllobranchiata there never is a branchial plume attached to this pair of appendages, excepting in the fresh-water genus *Atya*.

This same appendage has an ecphysis almost universally attached to the basis, although in some instances, as in *Spongicola*, it is reduced to a rudimentary condition (Pl. XXVIII. fig. *i*), and sometimes it is wanting altogether as in *Nauticaris marionis* (Pl. CVIII. fig. *i*).

In this division the apical termination is generally truncate and armed with spines; in some genera, as in *Pontonia*, *Acanthephyra*, *Palæmon*, and *Paralpheus*, it tapers to a point; in *Notostomus* it is obliquely truncate and pointed, while in *Nematocarcinus* it is spatuliform.

The First Pereiopoda.—The first pair of pereiopoda varies very considerably in form, power, and function. In all the genera of the Trichobranchiata it is the largest and most powerful of the pereiopoda, and excepting in the Synaxidea, and their parallel representatives the Haplopodea among the Phyllobranchiata, it is always chelate, and in these tribes it is frequently subchelate. It is often of too great a length to be of use as an organ for carrying food to the mouth; I believe it is generally only capable of being used for the purpose of holding food while the smaller hands are tearing it off, and carrying it to the mouth. In this way the Prawns and Lobsters feed. I also believe that the great weight adds to the power of the first pair of pereiopoda, and is of further value in assisting to retain or steady the animal, when, by its seizing some fixed body, it is thus prevented from being easily floated away.

It is, I think, by observing the habits of animals in ordinary conditions, that we are enabled to appreciate the value of extraordinary forms in exceptional circumstances. Thus in *Thaumastocheles zaleuca* the first pair of pereiopoda, with its long comb-like fingers, is perfectly useless for conveying food to the mouth, and can only aid the animal in the way that the Prawn uses its long second pair of feet, and the Soldier Crab

uses its larger hand, by holding its food while the smaller carries it to the mouth. We may suppose that the blind *Thaumastocheles*, resting upon a bed of Globigerina or Diatom ooze, can, by raking the surface of the mud, fill the long comb-like hand with multitudes of minute animals more or less adapted for its food; that then the smaller hands gather up the larger and more suitable portions, and carry them to the mouth. It is interesting to learn that a near ally of *Thaumastocheles zaleuca* appears to have existed so far back as the Cretaceous formation, in the species *Stenocheles esocinus* of Fritsch and Kafka;[1] but whether this was also a blind animal or not I do not know.

In the Dendrobranchiata the first is the smallest of the three chelate pairs characteristic of the division, one of which is large; the first is moreover the shortest, and appears from its relative length to be capable of reaching the mouth.

It is also noticeable in this division, that in those genera in which there is a downward tendency from the normal form and power, the change takes place at each extremity of the pereion. The first pereiopod is the first to become enfeebled, as may be seen in the Sergestidæ, in which the first has lost its chelate structure, and yet retains a grasping or holding power in the peculiar adaptation of the carpo-propodal articulation; while at the posterior extremity of the pereion the fifth pair has become little more than rudimentary, and the fourth is much diminished in importance and value.

In the Phyllobranchiata the first pair of pereiopoda varies greatly in relative form and size, being sometimes the largest, as in *Alpheus*, but more commonly very much the smallest, as in the Palæmonidæ; again, as in the Crangonidæ, it is reduced to a subchelate condition, in consequence of the polliciform angle of the propodos being reduced to a small tooth-like point, as in *Crangon* and its immediate congeners. In *Glyphocrangon* this point is altogether absent, and in *Nika* the change in structure differs on the two sides, this pair being simple on one side and chelate on the other. In the Pandalidæ it exists as a pair of simple pointed legs, styliform in appearance.

In the freshwater genus *Atya* this pair of pereiopoda is developed into a kind of brush to provide the mouth with supplies of fine mud on which the animal lives. The extremity of both the finger and thumb is provided with a tuft of long bristles, which, when the hand is open, form a kind of fan which retains the fine mud; when the hand is closed, the bristles are closed around the mud, compressing it into a pellet, which is passed into the mouth with great rapidity.[2]

The Second Pereiopoda.—The second pair of pereiopoda varies much in some families and but little in others. All through the Trichobranchiata it is chelate and only of moderate proportions, being much smaller than the first and as large as or larger

[1] Die Crustaceen der Böhmischen Kreideformation, 1887.
[2] Fritz Müller, *Kosmos*, Bd. viii. p. 117, 1881.

than the third; it has the carpos single-jointed, which is also the case in the Dendrobranchiata, the only difference being that in this division the second resembles the first, but is slightly larger and a little longer, corresponding in size between the first and second pairs.

We find that this is continued, but to a less degree, in the Sergestidæ, in which family the second pair corresponds more nearly with the third than with the first.

In the Phyllobranchiata the several variations of form are more marked and in stronger contrast. In the genera belonging to the families of the Nikidæ, Alpheidæ, Hippolytidæ, and Pandalidæ it is long, slender, minutely chelate, and has the carpos multiarticulate, the articuli varying in number and length in various species or genera.

In the Crangonidæ it is short, slender, and feeble, and the carpos is not multiarticulate, and this is also the case in all the genera belonging to the Palæmonidæ, only here it is larger and often very much longer than the first pair; so it is in *Typton*, *Pontonia*, and *Oodeopus*, while it differs in *Nematocarcinus* in being small and having the carpos long and slender, and not multiarticulate.

The differences between the multiarticulate condition of the carpos and those in which it is uniarticulate is so marked that I have separated them into two tribes, under the names of the Polycarpidea and Monocarpidea. In the Haplopodea all the legs are uniform.

The Third Pereiopoda.—The third pair of pereiopoda is chelate in all the genera of the Trichobranchiata, except in the group Synaxidea, in which none of them are chelate except the posterior in the females, the first being only subchelate in some genera. This part is generally small and subequal to, or smaller than, the second pair.

This chelate condition also exists in some of the aberrant forms, but in others, as in *Thalassina*, *Eiconaxius*, &c., it is simple. In the family Stenopidæ the third pair is large and chelate, having the hand long and slender in *Stenopus*, broad and thick in *Spongicola*, and in each longer than the preceding, thus acquiring the character and appearance of the Dendrobranchiata, whilst in the compressed rostrum it much resembles in external appearance the Phyllobranchiata.

In the Dendrobranchiata this pair is the largest and the longest of the chelate feet, and is universally formed on the same type as the two preceding. In the Sergestidæ it is chelate, but only minutely, as it is also in *Lucifer*, and in both cases it is buried in a brush of hairs. I have not had an opportunity of examining it in *Acetes*.

In the Phyllobranchiate forms the third pair of pereiopoda is universally simple.

In the Crangonidæ it is long, slender, and styliform; in the Nikidæ it resembles the succeeding and is less styliform than in the Crangonidæ. It is also styliform in the Pasiphæidæ but comparatively less so than in the Crangonidæ. In several genera

it is short and sickle-shaped, and sometimes biunguiculate, as in some species of the Alpheidæ and Hippolytidæ.

The Fourth Pereiopoda.—The fourth pair of pereiopoda undergoes little change throughout the entire order of the Macrura except in a few of the aberrant Anomura, and in the family of the Eryonidæ, in which they are chelate in several of the genera, as in *Polycheles*, *Pentacheles*, *Eryoneicus*, and *Willemœsia*. It is among the most constant in form and simple in character; it is absent only in the depreciated forms of *Acetes* and *Lucifer*, and even here it is the last to disappear. In the genus *Stenopus* the propodos is reduced to a multiarticulate condition, but is not enfeebled as in *Benthœcetes*, Smith, and the dactylos terminates in a biunguiculate extremity.

The Fifth Pereiopoda.—The fifth pereiopoda is a characteristic pair of appendages in many genera. It is, moreover, functionally an important pair, since it contains the termination of the internal portions of the male organs of generation, the extremity of the vas deferens passing through an orifice in the coxal joints (Pl. XV. fig. 3*o* and Pl. XIX. fig. *o*). In *Pentacheles* and *Willemœsia* it is chelate in both males and females. In the Scyllaridæ and Palinuridæ, Homaridæ and Astacidæ, it is chelate in the females only; and appears to be functionally so formed to assist in rupturing the ovisac and liberating the brephalos from the ova.

In the Trichobranchiata it is frequently simple in the male and chelate in the female.

In the Dendrobranchiata it is always simple in form, but has a tendency to become long, slender, and enfeebled; in some genera it is multiarticulate and filamentous, as in *Benthœcetes;* in *Sergestes* it becomes rudimentary in character, and in *Acetes* and *Lucifer* disappears altogether.

Throughout the Phyllobranchiata it is formed on the same general plan as that of the fourth pair, but varies in some genera in having the dactylos short; it is generally simple, but there are many genera in which the dactylos is reduced to a minute condition and attenuated in form.

In some genera, as in *Diaphoropus*, the fifth pair is developed to a very great length, far exceeding that of the preceding pairs. Unfortunately we only know the species of this genus in their young condition, so that although in the specimens of *Diaphoropus versipellis* (Pl. CXVII. fig. 3) it has a form approximating to that of the adult, yet it evidently has to undergo one more change before it reaches the permanent stage. This great size, which is chiefly due to the length of the limb and the diameter of the coxal and basisal joints, appears to belong to other genera, such as *Anebocaris* and *Eretmocaris;* but in the specimens of these genera the appendage is unfortunately wanting, the only part preserved being the large coxal joint (Pl. CXLV.).

In the Phyllobranchiata the great degree of degradation which is seen in some genera

of the Dendrobranchiata does not appear to take place in this pair, but rather in the penultimate pair, as in *Pasiphæa* (Pl. CXL. fig. 1*n*).

The First Pleopoda.—The first pair of pleopoda is an important pair of organs, deviating from the normal form seen in those posterior to it, and being utilised to assist the male to a greater or less extent in the act of copulation.

It frequently varies very considerably in form in the two sexes, but it is most pronounced in the males, in which, however, it shows considerable differences in form in different genera and families, but more decidedly in the several divisions into which the Macrura are divided.

The normal condition of the appendage is that of two foliaceous branches attached to the extremity of a basal joint, which is articulated to the inner wall of the plates that project on each side of the pleonic somites; these, so far as I know, have never received a special name, but are generally considered to be the lateral projections of the several somites. A similar condition of structure exists in the Edriophthalma, and since in these there is no carapace covering the pereion and shielding the branchiæ from accident, the first joint of the legs is produced in a similarly squamose manner, overlapping and protecting the branchiæ, situated pendent on the inner side.

I believe that this is precisely the condition of the great lateral plates on the pleon in the Macrura; an idea that I have long entertained, and which, I believe, is capable of demonstration by well-grounded arguments.

That the two rami are homotypical of the exopodite and the endopodite of the pereionic limb, as described by Milne-Edwards—or, as I have preferred to call them, of the pereiopod and its basecphysis (or in plain English the leg with the branch of its second joint) is, I believe, universally accepted as theoretically true; but the large overlapping lateral plate is figured and described as part of the somite by Milne-Edwards in his great work Histoire naturelle des Crustacés, while it is omitted in his later memoir on the morphology of the Decapod Crustacea.[1]

In the different genera the second or basisal joint of the appendage is seen to creep (as it were) down the side of the large scale often nearly as far as its lower margin; this is apparent in several species of *Alpheus* where it is largely developed, especially in the females as a protection for the ova. In some specimens of an undescribed genus recently taken in the "Talisman" by M. A. Milne-Edwards these lateral plates are so largely developed in the females that they wrap over and cover the ova as in a marsupial pouch. In other genera, as *Sergestes* and *Lucifer*, they are reduced to a minimum, having the pleopoda articulating at the extreme margin of the lateral wall. This we might suppose to be liable to occur in such genera as these, in neither of which are ova ever

[1] Observations sur le squelette tégumentaire des Crustacés décapodes et sur la morphologie de ces animaux, *Ann. d. Sci. Nat.*, sér. 3, t. xvi. pp. 221–291, pls. 8–11, 1851.

attached to the pleopoda. But large squamose plates exist also in *Penæus* and its congeners, which also so far as known never carry ova.

If we turn to *Apseudes*, that anomalous little genus, which appears in its general character and condition to be rather a Macruran than an Isopod, we find this lateral plate distinctly recognisable as a joint articulating with its somite, and with the basisal joint which supports its two branches attached at its extremity.

It appears to me that what is true of a small Crustacean is also true of a large one, and this interpretation is most consistent with the homology of these parts.

If the ecphysis or exopodite be a branch of the second joint, as it is acknowledged to be, then it is clear that the part generally denominated the peduncle of the pleopod must be the second joint, that is the basis, and not the coxa, or the branches arising from it cannot be the homologues of the basecphysis; or, finally, the branches springing from the first joint or coxa of the pereiopoda must also be homologically the same as those which spring from the second joint or basis; which is absurd, since it would make the exopodite and the epipodite, or as I have named them, the basecphysis and mastigobranchia, homologous with each other.

The pleopoda undergo various modifications of form, the three anterior more or less after one type, the three posterior after another; the first pair in the female varies but little from the succeeding which carry the ova, and what change there may be is in the direction of depreciation.

In the Trichobranchiata in the female it is very much reduced in character, and sometimes, as in the Astacidæ, it is almost rudimentary; whereas in the male of the same species it is a large and powerful organ adapted for its special purpose.

In *Astacus* it is developed into an almost cylindrical tube, but in the genera belonging to the family of the Eryonidæ it forms rather a broad spoon; and judging from what we have observed of the habits of the higher forms, as exhibited in *Carcinis mænas*, in which the extremity of the vas deferens is projected into folds of the first pair of pleopoda and inserted into the female, so in these, although in a less perfect manner, the pleopod may be utilised to similarly direct same organ to the entrance of the oviduct.

In *Ibaccus*, and I believe in all the Synaxidea, the first pair of pleopoda is wanting in both male and female, but in the Stenopidæ it is well developed, but only single-branched, and utilised in the female as an egg-carrier.

In the Dendrobranchiata even a greater change takes place in the male, and one that is well worthy of close consideration.

The inner branch is transformed into a very thin membranous plate, which I have called the petasma, and which is capable of very large extension; it generally lies folded longitudinally in a narrow compass, and is frequently studded at the proximate margins with hooks and teeth which vary in form; its minor differences are so numerous and

its general form so constant, that when fully developed it is a good and invariable test of specific character.

In *Lucifer* I have been able to follow the development of this organ throughout its various changes, from the very early form to the adult stage, with more completeness than in any other genus. Thus, when the animal is but 5 mm. in length, the petasma is present in the form of a bud; when the animal is 10 mm. long it has increased to a considerable degree, and when it has reached the adult stage it is about 12 mm. or half an inch long, the petasma is fully developed (Pl. LXXX. fig. 1, and *p.t.m.*). This organ may be seen varying (Pl. LXXXII.) from the simplest condition to that of the more perfect form through various genera; and is universally present in the adult as a pair of large veils which become linked together in the median line and form a curtain that stretches across the pleon between the limbs from one side to the other.

Whether this veil is constantly present in the adult male, or only at certain periods when required, I am not prepared to assert, but I am inclined to believe that the latter is the more likely case, if we may judge from certain specimens of *Aristeus* in the collection. For instance, on Pl. XLV. figs. 1, 2, and *p* are shown to exist in different degrees of immaturity, although the animals from which they were taken are all fully grown and well-developed males.

When displayed to the full extent they form a curtain, as may be seen in *Gennadas parvus* (Pl. LVII. fig. *p.p.*), in which they extend from the pleopod on one side to that on the other, being connected in the median line by a series of small cincinnuli (fig. *p.''*), and attached on each side by a small pedicle to near the middle of the basisal joint of the pleopoda. It may be also seen in a similar condition, but more irregular in form, in *Sergestes atlanticus* (Pl. LXIX. fig. *p.p.*). On Pl. XXXIX. fig. 2″ it is also shown in a folded condition, in *Pleoticus mülleri;* but perhaps its true value and importance may best be understood from an examination of the structure as it is shown in *Pleoticus pectinatus* (Pl. XXXVIII. fig. *p.p.*). Here the petasma is extended and united in the median line. The curtain is seen to be attached by a small pedicle to near the middle of the inner side of the basisal joint of the pleopod, its margins are extended vertically to the central body of the curtain, which forms a groove in the middle; near the middle of the lateral margins are two excavated spaces, into which the fifth pair of pereiopoda fall when required, and beyond them are two enlarged lobes with hollow apices, the object of which is not clear, unless it be to assist in clutching the fifth pair of pereiopoda when pressed down; beyond the lobes the margins are fringed with a series of long, curved, comb-like teeth, that are capable of securing a hold on the female when the animals are brought into contact.

From what we know of the means of fertilization in *Lucifer*, and from what Sars has shown in his Report on the Schizopoda of the Challenger collection,[1] I think we may

[1] Zool. Chall. Exp., part xxxvii. p. 74.

assume from the similar character of the petasma in the male *Lucifer*, and in the Penæidæ, that the means adapted for impregnating the female in *Lucifer* is also that in the Penæidæ. It has been long known, but only of late years demonstrated by Dr. Semper, and more recently by Professor Brooks, that spermatophores are developed by the male (Pl. LXXX. figs. 1, 2; Pl. LXXXI. figs. 3, 4), and at certain periods when required are liberated; that these are taken up and held until required, probably only for a limited period, and then projected and retained inserted in the female until the ova are impregnated, as shown on Pl. LXXXI. fig. 1♀ and 2♀. Since the petasma exists in all those Macrura which are known to impregnate the females by means of spermatophores, it is fair to assume that this organ, which shows a remarkable correlation of parts in relation to a special function, fulfils the office in a manner nearly as suggested.

In the males of many genera, and in the females of most of the Macrura that belong to the Phyllobranchiata, there is commonly present, on the inner margin of the inner branch, a long, blunt, style-like appendage, that I have named stylamblys, the apex of which, instead of being sharp, is crowned with numerous small hooks with enlarged points, which have been termed cincinnuli. The hooks are similar to those attached to the inner margin of the petasma on each side.

The Second Pleopoda.—The second pair of pleopoda is generally a modification of the type of the first, in the direction of those that are posterior to it. The branches are more normal in form, but the outer carries a stylamblys that is furnished with numerous small hooks or cincinnuli. In some genera, as *Sicyonia*, the inner branch is developed into an imperfect petasma (Pl. XLIII. fig. 2*q*). In *Penæus serratus* the inner branch, instead of being a broad and thin membranous plate, is long and narrow, somewhat like the outer one, and is furnished at the base with two globular organs (Pl. XXXVII. fig. 1*q*).

In *Callianassa* and its near ally *Cheramus* (Pl. I. fig. 2*q*) the first pair of pleopoda is generally absent, or reduced to a rudimentary condition; the second and third are long and slender, the inner ramus being cylindrical and biarticulate, while the outer is long and slender, and also biarticulate, the first joint being extremely long, and the distal one extremely minute; but this condition belongs more to the female than to the male, in which they are smaller and more simple (Pl. VIII. figs. *q*♀ and *q*♂; Pl. XIX. figs. *q*♀ and *q*♂). These distinctions are common throughout the Synaxidea, as well as in many of the aberrant genera.

In the Phyllobranchiata, the inner exists as a submembranous branch, somewhat like that of the Dendrobranchiata, but it differs in the two sexes, being a little broader in the males, and having the margins free from cilia. It varies in different genera or sometimes even in different species of the same genus, as may be seen in *Nematocarcinus*, in which it may be compared with the same organ as seen in *Oplophorus*.

The Third Pleopoda.—The third pair of pleopoda likewise exhibits some of the characteristics of those preceding, but in many genera, and more especially in those in which the anterior pairs depart less from the common type, it differs but little from those that follow. This and the following two are the chief egg-carriers in the Trichobranchiata and Phyllobranchiata, although in some genera they may be found on the second, and in *Stenopus* a few ova are attached to the first pair.

The Fourth and Fifth Pleopoda.—These pairs are generally only broad and leaf-like appendages.

The Sixth Pleopoda.—The sixth pair of pleopoda is the only feature that is invariably constant, existing in a more or less perfect form throughout the whole of the Macrura.

Its articulation with the somite differs from the preceding by the reduction of the large coxal plate to a rudimentary condition, and in its being placed at the postero-lateral angles. The basisal joint, instead of being long as in those anterior to it, is short, and the terminal branches are generally broad and leaf-like, but in some instances slender and style-like, as may be seen in *Thalassina* (Pl. III.), in *Cheiroplatea* (Pl. I. fig. *v.v*), and in other aberrant forms through the Anomura, where it may be seen in a rudimentary condition in the cancriform genera.

In the course of development it is the first appendage present of those that belong to the pleon, and it appears almost simultaneously with the antennæ, while the pereiopoda are yet in an incipient condition, and the other pleopoda are visible only as immature buds.

The basis, or peduncular joint, is short, and the two branches generally bear a strong resemblance to each other, although each of them possesses features peculiar to itself. The inner branch is generally the more flexible, and has the two margins similar and fringed with hairs, whereas the outer is generally slightly longer than the inner; the outer margin is smooth and strengthened by a strong rib, and is ciliated with hairs on the inner side and distal extremity only; it is divided by a diæresis, or transverse line of articulation. This feature is one that is very general in the Macrura, being present, so far as my experience teaches me, in each division, and absent only in the genera that belong to the families Palinuridæ, Scyllaridæ, and Eryonidæ.

In the Dendrobranchiata the diæresis is, I believe, universally present; but in some genera, as *Benthesicymus* and *Gennadas*, it is imperfect in character, although, even in these, a small bundle of muscular tissue occupies the position where the line of diæresis should be (Pl. LV. fig. 1*r*), thus demonstrating by its presence that previously there existed an articulation between the two parts; the muscles, ceasing to be of use, have gradually diminished in size and value. This pair of appendages bears a considerable analogy to the second pair of antennæ, the outer branch representing the scaphocerite; and to add to this comparison we find in the Atyidæ that the scaphocerite is furnished with a diæresis of similar character.

In some genera of the Schizopoda, which are aberrant Macrura, the inner branch is furnished with an otolith, similar to that which we find in the first joint of the peduncle of the first pair of antennæ in some of the Phyllobranchiata. The analogy that it bears to the first pair is moreover apparent in the filamentary character it assumes in *Tanais* and *Apseudes*, in the latter of which it exhibits the unusual feature of two filamentose branches, which is the normal condition of the Macrural antennæ.

The Telson.—The terminal or twenty-first somite—the seventh somite of the pleon—undergoes considerable degrees of modification throughout the several families of the Macrura.

In most genera the telson appears to be useful as being the resting-place of the sphincter muscles that surround the terminal extremity of the alimentary canal, which is capable of being controlled by them. It is also useful in directing and steering the animal in its passage through the water, and appears to be longest in those species that possess the greatest power of rapid movement.

All these animals possess the power of doubling up the posterior somites against the ventral surface of the pleon, and then, by boldly striking out, dart to a considerable distance.

In some genera, or even families, the telson is posteriorly rounded, as in the Astacidæ; in others it is anteriorly hard and calcareous and posteriorly soft and membranous, as in the Synaxidea, a circumstance that is suggestive of a distinct relationship of the two parts, the anterior which carries the anus belonging to the normal somite, while the posterior portion represents its appendages. This idea is still more strongly suggested in the genus *Cheiroplatea*, where the separation of the posterior from the anterior division is clearly defined by a distinct membranous articulation, and the posterior portion is divided into two lateral lobes.

In *Glyphocrangon* the telson is not only a long and slender appendage but it is one that from its character and power must be a formidable weapon of offence. It is developed in the form of a long, slightly curved, triangular bayonet, grooved along the upper surface, and capable of being firmly fixed or unlocked at will.

The contraction of the extensor muscle forces the ball-like portion at its anterior dorsal margin beneath the frontal surface of the preceding somite, and draws the dorsal process at the base of the telson into contact with the vertical margins at the posterior extremity of the sixth somite, and by the same action the lateral bolts are forced against the curved margin of the projecting lateral process on each side; by these means the telson is so securely locked in position that it is difficult to dislodge it when so fixed (Fig. XV.). To add to its power as a weapon of offence the sixth somite is attached to the fifth by a similarly formed articulation, which is also easily capable of being locked in position, and the fifth somite is united with the fourth by a modification of the same

kind, but less capable of resistance than the other two. These three somites therefore support each other, and by acting in concert when drawn up beneath the ventral surface of the animal, and then forcibly struck out, must be capable of inflicting a very severe wound.

There seems to be a curious correlation between the length of the telson and the length

FIG. XV.—*Glyphocrangon*. T, fifth somite of the pleon; V, sixth somite of the pleon; Z, telson.

of the rostrum. When the telson is long and slender the rostrum is also long and slender, and when the telson is short the rostrum is never long, and is frequently very short, or wanting, as in *Crangon* and the Synaxidea. The rostrum by its length appears to afford protection to the ophthalmopoda and the antennæ, and the telson, by its rigidity and length, likewise affords protection to the lateral appendages of the rhipidura.

GEOGRAPHICAL DISTRIBUTION.

LIST OF LOCALITIES AT WHICH MACRURA WERE OBTAINED, WITH THE SPECIES TAKEN AT EACH.

STATION VIIp. February 10, 1873; lat. 28° 35′ N., long 16° 5′ W.; off Gomera, Canary Islands; depth, 78 fathoms; bottom, volcanic sand. Dredged.

Arctus pygmæus (1 ♀).

STATION 13. March 4, 1873; lat. 21° 38′ N., long. 44° 39′ W.; Mid-north Atlantic; depth, 1900 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·8. Dredged.

Willemœsia leptodactyla (1 ♀). | *Bentheocaris stylorostratis* (2 ♀ ♂).

STATION 23. March 15, 1873; lat. 18° 24′ N., long. 63° 28′ W.; off Sombrero Island, West Indies; depth, 450 fathoms; bottom, Pteropod ooze. Dredged.

Callianassa occidentalis (1). | *Thaumastocheles zaleuca* (2).
Cheramus occidentalis (1). | *Polycheles crucifera* (1).
Benthesicymus pleocanthus (1 ♀).

STATION 24. March 25, 1873; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; off Culebra Island; depth, 390 fathoms; bottom, Pteropod ooze. Dredged.

Platybema rugosum (1 ♀). | *Leptochela serratorbita* (1).

St. Thomas, West Indies; shallow water.

Sicyonia carinata (1). | *Alpheus bermudensis* (1 ♀).
Leptochela serratorbita (1).

Bermuda; shallow water.

Stenopus hispidus. | *Alpheus bermudensis* (3 ♀ ♂).

Between Bermuda and the Azores. Surface.

Gennadas intermedius. | *Brachycarpus savignyii.*

North Atlantic. April 1873. Surface.

Mastigopus suhmi.
Sergestes edwardsii.
Sergestes atlanticus.
Sergestes ovatoculus.
Sergestes penerinkii.
Lucifer typus.
Lucifer reynaudii.

Latreutes ensiferus (100). On Gulf-weed.
Hippolyte bidentatus (2 ♂ ♀). On Gulf-weed.
Palæmon natator (113). On Gulf-weed.

Station 40. April 28, 1873; lat. 34° 51′ N., long. 68° 30′ W.; depth, 2675 fathoms; bottom, blue mud. Dredged.

Acanthephyra purpurea (1). | *Acanthephyra sicca* (1).

Station 42. April 30, 1873; lat. 35° 58′ N., long. 70° 35′ W.; surface temperature, 65°. Surface.

Sergestes atlanticus (1).

Station 45. May 3, 1873; lat. 38° 34′ N., long. 72° 10′ W.; south-east of New York; depth, 1240 fathoms; bottom, blue mud; bottom temperature, 37°·2. Dredged.

Gennadas parvus (1 ♂). | *Orphania tenuimana* (1).

Station 49. May 20, 1873; lat. 43° 3′ N., long. 63° 39′ W.; south of Halifax; depth, 85 fathoms; bottom, gravel, stones; bottom temperature, 35°. Dredged.

Sabinea septemcarinata (22 ♀ ♂).
Hippolyte projecta (1 ♂).
Spirontocaris spinus (many ♂ ♀).
Hetairus gaimardius (1 ♀).
Hetairus tenuis (1 ♂).
Hetairus debilis (15).
Pandalus falcipes (2 ♀ ♂).

Station 57. May 30, 1873; lat. 32° 11′ 7″ N., long. 65° 3′ 20″ W.; off Bermuda; depth, 690 fathoms. Dredged.

Nephropsis rosea.

Stations 62 and 63. June 18, 19, 1873; lat. 35° 7′ to 35° 29′ N., long. 50° 53′ to 52° 32′ W. Surface, among Gulf-weed.

Sergestes atlanticus (3 ♂ ♀).
Hippolyte bidentatus (1 ♀). Female with ova.

STATION 84. July 18, 1873; lat. 30° 38′ N., long. 18° 5′ W.; near the Canary Islands; surface temperature, 71°. Surface.

Stochasmus exilis (1).

STATION 87. July 21, 1873; lat. 25° 49′ N., long. 20° 12′ W.; off the Canary Islands; depth, 1675 fathoms; bottom, rock. Dredged.

Acanthephyra purpurea (1). | *Eryoneicus cæcus*[1] (1).

Hymenodora mollicutis (1 ♂).

South Atlantic, March 1876.

Amphion provocatoris (1).

Off Cape Verde Islands. Surface.

Arctus immaturus (1).
Sergestes edwardsii (April 26, 1876).
Athanas veloculus (2).
Diaphoropus longidorsalis (1) (April 26, 1876).
Oodeopus gibbosus (April 26, 1876).
Hectarthropus tenuis (April 26, 1876).
Eretmocaris stylorostris (April 26, 1876).
Eretmocaris corniger (April 26, 1876).

St. Vincent, Cape Verde Islands; 7 to 52 fathoms.

Ibaccus verdi.
Phyllosoma furcicaudatum.
Phyllosoma verdense.
Sicyonia sculpta (1).
Sergestes dissimilis.
Alpheus edwardsii.
Alpheus cristidigitus (19 ♀ ♂).
Alpheus edwardsii (10 ?).

Amphion provocatoris (1).

San Iago, Cape Verde Islands; fresh-water stream.

Atya sulcatipes. | *Atya serrata.*

Caridina typus.

STATION 101. August 19, 1873; lat. 5° 48′ N., long. 14° 20′ W.; near Sierra Leone; depth, 2500 fathoms; bottom, blue mud; bottom temperature, 36°·4. Trawled.

Gennadas parvus (1).

STATION 103. August 22, 1873; lat. 2° 52′ N., long. 17° 0′ W.; surface temperature, 77°. Surface.

Sergestes oculatus (1).

[1] A second and much larger species has been since taken by Professor A. Milne-Edwards during the voyage of the "Talisman."

Station 104. August 23, 1873; lat. 2° 25′ N., long. 20° 1′ W.; depth, 2500 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·6. Trawled.

Haliporus lævis (2 ♀). | *Acanthephyra kingsleyi* (1 ♂).

Hymenodora mollicutis (1 ♀).

Station 106. August 25, 1873; lat. 1° 47′ N., long. 24° 26′ W.; depth, 1850 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·6. Trawled.

Haliporus lævis (1 ♂). | *Sergestes oculatus* (4).
Gennadas intermedius (1). | *Sergestes longispinus* (1).

Acanthephyra acanthitelsonis (1 ♂).

Tropical Atlantic. Surface.

Lucifer typus. | *Sergestes parvidens.*
Lucifer reynaudii. | *Peteinura gubernata*, at night.

Station 107. August 26, 1873; lat. 1° 22′ N., long. 26° 36′ W.; depth, 1500 fathoms; bottom, Globigerina ooze; bottom temperature, 37°·9. Trawled.

Acanthephyra acanthitelsonis (1 ♂). | *Acanthephyra brevirostratis* (2).

St. Paul's Rocks. Surface.

Panulirus guttatus (3 ♀ 1 ♂). | *Lucifer reynaudii.*
Lucifer typus. | *Alpheus minus* (2 ♀).

Sergestes oculatus (6).

Station 113a. September 2, 1873; lat. 3° 47′ 0″ S., long. 32° 24′ 30″ W.; off Fernando Noronha; depth, 7 to 25 fathoms; bottom, volcanic sand and gravel.

Artemesia longinaris (1). | *Alpheus minus* (1 ♀).

Station 120. September 9, 1873; lat. 8° 37′ S., long. 34° 28′ W.; off Pernambuco; depth, 675 fathoms; bottom, red mud. Trawled.

Gennadus parvus (1 ♀). | *Notostomus brevirostris* (1).
Glyphocrangon aculeata (1 ♀). | *Hymenodora mollis* (1 ♀).

Station 122. September 10, 1873; lat. 9° 5′ S., long. 34° 50′ W.; off Barra Grande; depth, 350 fathoms; bottom, red mud. Trawled.

Amphiplectus depressus (2 ♀). | *Plesionika semilævis* (16).
Plesionika uniproducta (2 ♂ ♀). | *Nothocaris geniculatus* (17 ♀ ♂).

Campylonotus capensis (2 ♂).

Station 126. September 12, 1873; lat. 10° 46′ S., long. 36° 8′ W.; depth, 770 fathoms; bottom, red mud. Trawled.

Acanthephyra edwardsii (2 ♂ ♀)

Off Bahia; from 7 to 22 fathoms.

Sicyonia carinata. | *Alpheus minus* (3 ♀ ♂).
Alpheus intrinsecus (1 ♀).

South Atlantic, October 5, 1873; about lat. 28° S., long. 27° W. Surface.

Sergestes longicollus.

Station 133. October 11, 1873; lat. 35° 41′ S., long. 20° 55′ W.; near Tristan da Cunha; depth, 1900 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·4. Trawled.

Willemœsia leptodactyla (1 ♀).
Hemipenæus spinidorsalis (2).
Aristeus armatus (1 ♂).
Benthesicymus iridescens (2 ♀ ♂).
Benthesicymus altus (3 ♂).
Benthesicymus mollis (1).
Pontophilus gracilis (1 ♀).
Notostomus murrayi (1).
Hymenodora mollicutis (2 ♂ ♀).

Station 135c. October 17, 1873; lat. 37° 25′ 30″ S., long. 12° 28′ 30″ W.; Nightingale Island, Tristan da Cunha; depth, 110 fathoms. Dredged.

Palinosytus lalandii (1).

Station 137. October 23, 1873; lat. 35° 59′ S., long. 1° 34′ E.; depth, 2550 fathoms; bottom, red clay; bottom temperature, 34°·5. Dredged.

Gennadas intermedius (1 ♂). | *Sergestes profundus* (1 ♀).

Station 142. December 18, 1873; lat. 35° 4′ S., long. 18° 37′ E.; Agulhas Bank; depth, 150 fathoms; bottom, green sand; bottom temperature, 47°. Dredged.

Merhippolyte agulhasensis (5 ♂ ♀). | *Pandalus modestus* (3).
Chlorotocus incertus (1).

Station 144a. December 26, 1873; lat. 46° 48′ 0″ S., long. 37° 49′ 30″ E.; off Marion Island; depth, 69 fathoms; bottom, volcanic sand. Dredged.

Nauticaris marionis (67 ♀ ♂).

Station 145. December 27, 1873; lat. 46° 43′ 0″ S., long. 38° 4′ 30″ E.; off Marion Island; depth, 140 fathoms; bottom, volcanic sand. Dredged.

Nauticaris marionis (3). | *Chorismus tuberculatus.*
Campylonotus capensis (6 ♂ ♀).

Station 145a. December 27, 1873; lat. 46° 41′ S., long. 38° 10′ E.; off Marion Island; depth, 310 fathoms; bottom, volcanic sand. Dredged.

Chorismus tuberculatus (15 ♀ ♂).

Station 146. December 29, 1873; lat. 46° 46′ S., long. 45° 31′ E.; near Marion Island; depth, 1375 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·6. Trawled.

Petalidium foliaceum (4 ♀). | *Caricyphus angulatus* (1).
Glyphocrangon podager (1 ♀). | *Nematocarcinus proximatus* (2 ♀).

Station 147. December 30, 1873; lat. 46° 16′ S., long. 48° 27′ E.; depth, 1600 fathoms; bottom, Diatom ooze; bottom temperature, 34°·2. Trawled.

Hymenodora duplex (1 ♀).

Station 152. July 11, 1874; lat. 60° 52′ S., long. 80° 20′ E.; depth, 1260 fathoms; bottom, Diatom ooze. Trawled.

Nematocarcinus lanceopes (3 ♀ ♂).

Station 156. February 26, 1874; lat. 62° 26′ S., long. 95° 44′ E.; depth, 1975 fathoms; bottom, Diatom ooze. Trawled.

Hymenodora mollicutis (1 ♂).

Station 157. March 3, 1874; lat. 53° 55′ S., long. 108° 35′ E.; depth, 1950 fathoms; bottom, Diatom ooze; bottom temperature, 32°·1. Trawled.

Hymenodora mollicutis (2 ♂).

South of Australia; March 1874. Surface.

Sergestes dorsispinalis. | *Sergestes laterodentatus.*

STATION 159. March 10, 1874; lat. 47° 25′ S., long. 130° 22′ E.; depth, 2150 fathoms; bottom, Globigerina ooze; bottom temperature, 34°·5. Trawled.

Gennadas parvus (1).
Petalidium foliaceum (1 ♀).
Sergestes atlanticus (3 ♀).
Acanthephyra sica (2 ♂).
Hymenodora glauca (1 ♂).

STATION 162. April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ 0″ E.; off East Moncœur Island; depth, 38 fathoms; bottom, sand and shells. Dredged.

Alpheus gracilipes (2).
Leptochela robusta (16 ♀ ♂).

Australia, off Cape Howe; April 3, 1874. Surface.

Icotopus arcurostris (2).
Diaphoropus versipellis, at night.
Zoontocaris galatheæ.
Oodeopus serratus.

Australia, Port Jackson. Surface.

Penæus canaliculatus, var. *australiensis* (3 ♀).
Penæus gracilis.
Sergestes armatus.
Lucifer typus.
Palæmon affinis (16 ♀).
Anebocaris quadroculus (1), at night.

Sydney, Paramatta River, N.S.W. Fresh-water.

Astacopsis spinifer.
Astacopsis sydneyensis.
Astacopsis paramattensis.

Sydney.

Sergestes parvidens.

STATION 164B. June 13, 1874; lat. 34° 13′ S., long. 151° 38′ E; off Port Jackson; depth, 410 fathoms; bottom, green mud. Trawled.

Plesionika semilævis (2).

STATION 165. June 17, 1874; lat. 34° 50′ S., long. 155° 28′ E.; off Sydney; depth, 2600 fathoms; bottom, red clay; bottom temperature, 34°·5. Dredged.

Pontophilus profundus (1 ♂).

STATION 166. June 23, 1874; lat. 38° 50′ S., long. 169° 20′ E.; off New Zealand; depth, 275 fathoms; bottom, Globigerina ooze; bottom temperature, 50°·8. Trawled.

Nephrops thomsoni (1 ♀).
Pandalus magnoculus (9 ♀ ♂).

STATION 167. June 24, 1874; lat. 39° 32′ S., long. 171° 48′ E.; off New Zealand; depth, 150 fathoms; bottom, blue mud. Trawled.

Ibaccus alticrenatus (2 ♂ 2 ♀). | *Pandalus magnoculus* (14 ♀ ♂).

STATION 167A. June 27, 1874; lat. 41° 4′ S., long. 174° 19′ E.; off New Zealand; depth, 10 fathoms; bottom, mud. Dredged.

Brachycarpus audouinii (1 ♀).

STATION 168. July8, 1874; lat. 40° 28′ S., long. 177° 43′ E.; off New Zealand; depth, 1100 fathoms; bottom, blue mud; bottom temperature, 37°·2. Trawled.

Benthesicymus brasiliensis (2 ♀). | *Pontophilus gracilis* (6 ♂ ♀).
Acanthephyra sica (4 ♀ ♂).

Wellington, New Zealand.

Sergestes parvidens.

STATION 169. July 10, 1874; lat. 37° 34′ S., long. 179° 22′ E.; off New Zealand; depth, 700 fathoms; bottom, blue mud; bottom temperature, 40°. Trawled.

Pontocaris propensalata (1). | *Nematocarcinus serratus* (1).
Pleoticus lucasii. | *Nematocarcinus hiatus* (1).
Acanthephyra sica (3 ♀ ♂). |

STATION 170. July 14, 1874; lat. 29° 45′ S., long. 178° 14′ W.; off the Kermadec Islands; depth, 520 fathoms; bottom, volcanic mud; bottom temperature, 43°. Trawled.

Eiconaxius parvus. | *Benthesicymus altus* (1).
Polycheles helleri (1). | *Sergestes kroyeri* (1 ♀).
Pentacheles euthrix. | *Plesionika semilævis* (6 ♀ ♂).
Haliporus obliquirostris (many ♀). | *Acanthephyra sica* (1 ♂).
Hemipenæus semidentatus (3 ♀ ♂). | *Acanthephyra brachytelsonis* (4 ♀ ♂).

STATION 170A. July 14, 1874; lat. 29° 45′ S., long. 178° 11′ W.; near the Kermadec Islands; depth, 630 fathoms; bottom, volcanic mud; bottom temperature, 39°·5. Trawled.

Pentacheles euthrix (2 ♀). | *Acanthephyra sica.*
Eiconaxius parvus. | *Acanthephyra brachytelsonis* (4).

Station 171. July 15, 1874; lat. 28° 33′ S., long. 177° 50′ W.; north of the Kermadec Islands; depth, 600 fathoms; bottom, hard ground; bottom temperature, 39°·5. Trawled.

Eiconaxius kermadeci.
Hemipenæus semidentatus (1 ♀).
Aristeus semidentatus.
Benthesicymus iridescens.
Benthesicymus altus.
Glyphocrangon regalis (1 ♂).
Acanthephyra brachytelsonis (1).
Nematocarcinus undulatipes (3 ♂).
Nematocarcinus gracilis (1).
Stylodactylus discissipes (2 ♀ ♂).
Stylodactylus orientalis (1 ♀).

Station 172. July 22, 1874; lat. 20° 58′ S., long. 175° 9′ W.; off Nukalofa, Tongatabu; depth, 18 fathoms; bottom, coral mud. Dredged.

Alpheus avarus (2 ♂).

Station 173. July 24, 1874; lat. 19° 9′ 35″ S., long. 179° 41′ 50″ E.; off Matuku, Fiji Islands; depth, 315 fathoms; bottom, coral mud. Dredged.

Thalassina scorpionoides (1).
Polycheles baccata (1).
Pentacheles euthrix (1 ♂).
Penæus rectacutus (5 ♀).
Penæus serratus (1).
Aristeus rostridentatus (3 ♀).
Benthesicymus brasiliensis (1 ♂).
Sergestes atlanticus (1 ♂).
Glyphocrangon regalis (1 ♂).
Plesionika semilævis (7 ♂ ♀).
Pasiphæa cristata (1 ♀).

Levuka, Fiji Islands.

Betæus malleodigitus (1 ♀).
Betæus microstylus (1).

Station 174b. August 3, 1874; lat. 19° 6′ 45″ S., long. 178° 17′ 0″ E.; off Kandavu; depth, 255 fathoms; bottom, coral mud. Trawled.

Benthesicymus altus.
Nematocarcinus gracilis.
Nematocarcinus paucidentatus.
Nematocarcinus tenuirostris.

Station 174c. August 3, 1874; lat. 19° 7′ 50″ S., long. 178° 19′ 35″ E.; off Kandavu; depth, 610 fathoms; bottom, coral mud; bottom temperature, 39°. Trawled.

Pentacheles gracilis (1).
Stereomastis auriculata (1).
Benthesicymus altus (1).
Oplophorus longirostris (1 ♀).
Nematocarcinus gracilis (2 ♂).
Nematocarcinus paucidentatus (1).
Nematocarcinus tenuirostris (2 ♀).

Fiji Islands. Surface.

Penæus canaliculatus (many ♀ ♂).
Lucifer reynaudii.
Thalassocaris danæ (1). August 11, 1874.
Thalassocaris stimpsoni (2). August 11, 1874.
Oodeopus duplex.
Oodeopus serratus.

Off Kandavu, Fiji Islands.

Thalassina scorpionoides.
Stenopus hispidus.
Caricyphus serramarginis (1). August 11, 1874.

Kandavu. Fresh-water.

Bithynis lar (23 ♂ ♀).

Ovalau, Fiji Islands. Fresh-water rivers.

Bithynis lar.

Station 175. August 12, 1874; lat. 19° 2′ S., long. 177° 10′ E.; Fiji Islands; depth, 1350 fathoms; bottom, Globigerina ooze; bottom temperature, 36°. Trawled.

Glyphocrangon acuminata (22 ♀ ♂).

Station 176. August 15, 1874; lat. 18° 30′ S., long. 173° 52′ E.; off the New Hebrides.

Nematocarcinus productus.

Station 177. August 18, 1874; lat. 16° 45′ S., long. 168° 7′ E.; off the New Hebrides; depth, 130 fathoms; bottom, volcanic sand. Dredged.

Hemipenæus tomentosus (1 ♀).

New Hebrides. Surface.

Penæus gracilis.
Sergestes rinkii.
Sergestes ancylops.
Lucifer reynaudii.
Oodeopus serratus.
Oodeopus armatus.
Oodeopus duplex.

Between Api and Cape York. Surface.

Rhomaleocaris hamulus.
Hectarthropus compressus (1).

Station 181. August 25, 1874; lat. 13° 15′ S., long. 151° 49′ E.; depth, 2440 fathoms; bottom, red clay; bottom temperature, 35°·8. Trawled.

Benthesicymus brasiliensis (1 ♂).
Acanthephyra sica (1).

STATION 184. August 29, 1874; lat. 12° 8′ S., long. 145° 10′ E.; near Torres Strait; depth, 1400 fathoms; bottom, Globigerina ooze; bottom temperature, 36°. Trawled.

Penæus velutinus (2).
Penæus serratus (1).
Aristeus armatus (3 ♂ ♀).
Benthesicymus brasiliensis (4 ♀ ♂).
Benthesicymus altus (1).
Pontophilus gracilis (1 ♂).
Tropiocaris tenuipes (1 ♂).
Hymenodora rostrata (1 ♂).

Cape York.

Sergestes corniculum.
Pontonia meleagrinæ. (Presented to the Challenger at Sydney.)
Oodeopus geminidentatus.
Oodeopus armatus.
Oodeopus intermedius.
Oodeopus duplex.

Albany Island, Cape York.

Alpheus avarus.
Alpheus crassimanus.
Betæus microstylus (1).
Paralpheus diversimanus (2 ♂ ♀).

STATION 186. September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; Flinders Passage, Cape York; depth, 8 fathoms; bottom, coral mud. Dredged.

Penæus velutinus (2).
Cheirothrix parvimanus (1).
Alpheus acutofemoratus.
Paralpheus diversimanus (6 ♀ ♂).
Synalpheus falcatus (6 ♀ ♂).

STATION 187. September 9, 1874; lat. 10° 36′ S., long. 141° 55′ E.; Torres Strait; depth, 6 fathoms; bottom, coral mud. Dredged.

Penæus velutinus (2 ♀).

STATION 188. September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; Arafura Sea; depth, 28 fathoms; bottom, green mud. Trawled and dredged.

Cheramus orientalis (1).
Thenus orientalis (1).
Penæus monodon (2).
Penæus velutinus (43).
Penæus incisipes (7).
Penæus anchoralis (7 ♂ ♀).
Pleoticus pectinatus (1 ♂).
Sicyonia lancifer (1).
Dorodotes levicarina (2 ♂).
Nematocarcinus proximatus (15 ♂ ♀).

Station 190. September 12, 1874; lat. 8° 56′ S., long. 136° 5′ E.; Arafura Sea; depth, 49 fathoms; bottom, green mud. Trawled.

Arctus tuberculatus (2).
Penæus velutinus (19).
Penæus incisipes (1).
Penæus anchoralis (2 ♂).
Penæus fissurus (3 ♂ ♀).
Pontocaris pinnata (3 ♀ ♂).
Nothocaris binoculus (4 ♀ ♂).

Arafura Sea.

Penæus anchoralis (1 ♂).
Lucifer typus.
Lucifer reynaudii.
Alpheus avarus.
Alpheus neptunus (1 ♀).

Station 191. September 23, 1874; lat. 5° 41′ 0″ S., long. 134° 4′ 30″ E.; off the Arrou Islands; depth, 800 fathoms; bottom, green mud. Trawled.

Phoberus tenuimanus (1).
Nephropsis sukmi (1).
Haliporus neptunus (2).
Merhippolyte orientalis (1).
Acanthephyra acutifrons (1 ♂).
Proclete̊s biangulatus (1).

Station 192. September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; off Papua; depth, 140 fathoms; bottom, blue mud. Trawled.

Arctus sordidus (2).
Ibaccus brevipes (1).
Pontocaris propensalata (1 ♂).
Penæus philippinensis (2 ♂).
Nothocaris rostricrescentis (1).
Pleoticus lucasii (1 ♀).

Station 194. September 29, 1874; lat. 4° 34′ 0″ S., long. 129° 57′ 30″ E.; off Banda Island; depth, 200 fathoms; bottom, volcanic mud. Dredged.

Cheiroplatea cenobita (1 ♀).
Hemipenæus semidentatus (1 ♀).
Glyphocrangon regalis (1 ♀).
Heterocarpus dorsalis (2 ♀).
Heterocarpus lævigatus (1 ♂).
Acanthephyra angusta (2).
Acanthephyra sica (4).
Acanthephyra armata (1 ♂).
Acanthephyra brachytelsonis (2).
Nematocarcinus undulatipes (1 ♀).

Station 194a. September 29, 1874; lat. 4° 31′ 0″ S., long. 129° 57′ 20″ E.; off Banda Island; depth, 360 fathoms; bottom, volcanic mud. Trawled.

Eiconaxius acutifrons (1).
Cheiroplatea cenobita (1).

Station 195. October 3, 1874; lat. 4° 21′ S., long. 129° 7′ E.; off Banda Island; depth, 1425 fathoms; bottom, blue mud; bottom temperature, 38°. Trawled.

Dorodotes reflexus (1 ♂).
Nematocarcinus productus (1 ♀).
Notostomus longirostris (1 ♂).

Banda Island. Fresh-water.

Bithynis lar (3 ♀).

Amboina.

Scallasis amboinæ (1). | *Nika processa* (1 ♀).

Celebes Sea.

Oodeopus longispinus. October 1874.

Station 196. October 13, 1874; lat. 0° 48′ 30″ S., long. 126° 58′ 30″ E.; near the Philippine Islands; depth, 825 fathoms; bottom, hard ground; bottom temperature, 36°·9. Trawled.

Haliporus neptunus (3 ♀ ♂). | *Oplophorus typus* (1 ♀).

Station 198. October 26, 1874; lat. 2° 55′ N., long. 124° 53′ E.; near the Philippine Islands; depth, 2150 fathoms; bottom, blue mud; bottom temperature, 38°·9. Trawled.

Pontophilus gracilis (2 ♀). | *Nematocarcinus altus* (1 ♂).
Acanthephyra longidens (1 ♂). | *Notostomus patentissimus* (1 ♀).
Notostomus perlatus (1 ♂).

Philippine Islands. Surface.

Phyllosoma philippinense. | *Lucifer typus.*
Lucifer reynaudii.

Station 200. October 23, 1874; lat. 6° 47′ N., long. 122° 28′ E.; off Sibago, Philippine Islands; depth, 250 fathoms; bottom, green mud. Trawled.

Ibaccus verdi (1). | *Heterocarpus ensifer* (2 ♂).
Haliporus equalis (7 ♀). | *Plesionika semilævis* (16 ♀ ♂).
Hemipenæus virilis (2 ♂). | *Plesionika brevirostris* (1 ♀).
Hemipenæus tomentosus (2 ♀). | *Palæmonella orientalis* (1).
Pontophilus junceus (1 ♀). | *Nematocarcinus undulipes* (15 ♀ ♂).

Off Sibago, Philippine Islands; October 23, 1874.

Sestertius duplicidentes. | *Latreutes unidentatus.*
Parathanas decorticus (1). 80 fathoms. | *Kyptocaris stylofrontalis* (1).
Latreutes planus (1). | *Anebocaris quadroculus* (1).
Oodeopus serratus.

Off Basilan Strait, October 23, 1874. Surface.

Anebocaris quadroculus (5). | *Hectarthropus exilis.*

Hectarthropus expansus.

Station 201. October 26, 1874; lat. 7° 3′ N., long. 121° 48′ E.; Basilan Strait; depth, 82 fathoms; bottom, stones, gravel. Trawled.

Penæus philippinensis (27 ♀ ♂). | *Nothocaris ocellus* (2 ♀ ♂).

Off Samboangan, Philippine Islands.

Lucifer typus. | *Alpheus crinitus* (1 ♂).

Sestertius duplicidentes. | *Caricyphus cornutus* (1).

Bithynus lar (4 ♂ ♀). Fresh-water.

Mindanao, Philippines.

Zoontocaris approximus. | *Bithynis lar.* Fresh-water.

Station 203. October 31, 1874; lat. 11° 6′ N., long. 123° 9′ E.; off Panay, Philippines; depth, 20 fathoms; bottom, mud. Trawled.

Penæus indicus (1). | *Penæus incisipes* (4).

Penæus monodon (2). | *Alpheus leviusculus* (1 ♀).

Station 204A. November 2, 1874; lat. 12° 43′ N., long. 122° 9′ E.; off Tablas Island; depth, 100 fathoms; bottom, green mud. Trawled.

Nephrops thomsoni (1 ♂). | *Penæus fissurus* (1).

Station 204B. November 2, 1874; lat. 12° 46′ N., long. 122° 10′ E.; off Tablas Island; depth, 115 fathoms; bottom, green mud. Trawled.

Penæus fissurus (2 ♀).

Station 205. November 13, 1874; lat. 16° 42′ N., long. 119° 22′ E.; off Luzon Island; depth, 1050 fathoms; bottom, blue mud; bottom temperature, 37°. Trawled.

Haliporus lævis (1 ♀). | *Dorodotes reflexus* (2 ♀ ♂).

Benthesicymus pleocanthus (2 ♀ ♂). | *Nematocarcinus productus* (6 ♀ ♂).

Benthesicymus altus (1 ♀). | *Hymenodora rostrata* (1 ♂).

Station 206. January 8, 1875; lat. 17° 54′ N., long. 117° 14′ E.; off Luzon Island; depth, 2100 fathoms; bottom, blue mud; bottom temperature, 36°·5. Trawled.

Gennadas parvus (♀).

China Sea, off Luzon. Surface.

Sergestes intermedius.
Sergestes reynaudii.
Caricyphus turgidus (1).
Anebocaris quadroculus (1).

Off Hong Kong; depth, 10 fathoms.

Alpheus rapax (1 ♂).
Nauticaris unirecedens (1 ♀).

STATION 207. January 16, 1875; lat. 12° 21′ N., long. 122° 15′ E.; off Tablas Island, Philippines; depth, 700 fathoms; bottom, blue mud; bottom temperature, 51°·6. Trawled.

Hemipenæus gracilis (6 ♀ ♂).
Sergestes japonicus (2 ♀).
Heterocarpus gibbosus (1).
Acanthephyra media (2 ♀ ♂).
Oplophorus brevirostris (1).

STATION 208. January 17, 1875; lat. 11° 37′ N., long. 123° 31′ E.; off Manilla; depth, 18 fathoms; bottom, blue mud. Trawled.

Alpheus crinitus, Dana (1 ♀).
Alpheus spiniger, Stimpson (1 ♀).
Alpheus biunguiculatus (2 ♀).

Zebu Harbour.

Parathanas immaturus.
Anebocaris quadroculus (3).

STATION 209. January 22, 1875; lat. 10° 14′ N., long. 123° 54′ E.; off Zebu, Philippines; depth, 95 fathoms; bottom, blue mud; bottom temperature, 71°. Trawled and dredged.

Arctus orientalis (2 ♀ ♂).
Spongicola venusta (many ♀ ♂).
Penæus fissurus (10 ♀ ♂).
Penæus rectacutus (1 ♀).

STATION 213. February 8, 1875; lat. 5° 47′ N., long. 124° 1′ E.; south of the Philippines; depth, 2050 fathoms; bottom, blue mud; bottom temperature, 38°·8. Trawled.

Hemipenæus spinidorsalis (1).
Aristeus armatus (1).
Alpheus minus (1).
Acanthephyra acutifrons (1 ♂).

Station 214. February 10, 1875; lat. 4° 33′ N., long. 127° 6′ E.; south of the Philippines; depth, 500 fathoms; bottom, blue mud; bottom temperature 41°·8. Trawled.

Pentacheles lævis (1 ♀).
Benthesicymus altus (3 ♂).
Heterocarpus alphonsi (14 ♀ ♂).
Acanthephyra brachytelsonis (3).
Acanthephyra acutifrons (1).
Nematocarcinus undulatipes (3 ♂ ♀).
Nematocarcinus tenuirostris (5).

Station 215. February 12, 1875; lat. 4° 19′ N., long. 130° 15′ E.; near the Philippine Islands; depth, 2550 fathoms; bottom, red clay; bottom temperature, 35°·4. Trawled.

Hymenodora glauca (1).

Station 218. March 1, 1875; lat. 2° 33′ S., long. 144° 4′ E.; north of New Guinea; depth, 1070 fathoms; bottom, blue mud; bottom temperature, 36°·4. Trawled.

Paraxius altus (1).
Polycheles helleri (1).
Pentacheles obscura (1).
Glyphocrangon granulosis (2 ♀ ♂).
Nematocarcinus tenuipes (1 ♂).
Nematocarcinus intermedius (2 ♀ ♂).

Station 219. March 10, 1875; lat. 1° 54′ 0″ S., long. 146° 39′ 40″ E.; north of New Guinea; depth, 150 fathoms; bottom, coral mud. Trawled.

Panulirus angulatus (1).
Penæus philippinensis (10 ♂ ♀).
Sicyonia lævis (1).
Plesionika spinipes (8 ♂ ♀).
Plesionika unidens (4 ♂ ♀).
Stylodactylus bimaxillaris (1 ♀).

Station 220. March 11, 1875; lat. 0° 42′ S., long. 147° 0′ E.; north of New Guinea; depth, 1100 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·2. Trawled.

Gennadas parvus (3 ♀).
Oplophorus typus (1 ♀).

North of New Guinea. Surface.

Sergestes corniculum.
Sergestes lævi ventralis.
Sciacaris telsonis.
Amphion zoea.

Station 227. March 27, 1875; lat. 17° 29′ N., long. 141° 21′ E.; surface temperature, 79°·2. Surface.

Eretmocaris longicaulis (1).

Station 230. April 5, 1875; lat. 26° 29′ N., long. 137° 57′ E.; south of Japan; depth, 2425 fathoms; bottom, red clay; bottom temperature, 35°·5. Trawled.

Gennadas parvus (1 ♂). | *Acanthephyra sica* (2 ♂).
Tropiocaris planipes (1 ♀).

Japan.

Penæus canaliculatus, var. *japonicus*.

Off Yokoska, Japan; depth, 5 to 20 fathoms.

Crangon vulgaris. | *Alpheus longimanus* (4 ♀).

Station 232. May 12, 1875; lat. 35° 11′ N., long 139° 28′ E.; *Hyalonema*-ground, off Japan; depth, 345 fathoms; bottom, green mud; bottom temperature, 41°·1. Trawled and dredged.

Benthesicymus altus (1). | *Heterocarpus alphonsi* (1 ♂).
Gennadas parvus (4 ♀ ♂). | *Acanthephyra brachytelsonis* (3 ♀ ♂).
Sergestes atlanticus (1 ♀). | *Systellaspis lanceocaudata* (1).
Glyphocrangon hastacauda (1 ♀). | *Nematocarcinus tenuipes* (6 ♂ ♀).

Station 233. May 17, 1875; lat. 34° 39′ N., long. 135° 14′ E.; Bay of Kobé, Japan; depth, 8 fathoms; bottom, mud. Dredged.

Penæus velutinus (21). | *Alpheus longimanus* (4 ♀ ♂).
Crangon affinis, de Haan (8 ♀). | *Alpheus longimanus* (4).

Station 233a. May 19, 1875; lat. 34° 38′ N., long. 135° 1′ E.; off Japan; depth, 50 fathoms; bottom, sand. Dredged.

Crangon affinis (4 ♀). | *Nauticaris futilirostris* (1).
Leptochela gracilis (2 ♀ ♂).

Station 233b. May 26, 1875; lat. 34° 18′ N., long. 133° 35′ E.; depth, 15 fathoms; bottom, blue mud. Trawled.

Crangon affinis (4 ♀ ♂).

(?) Station 234. June 3, 1875; lat. 32° 31′ N., long. 135° 39′ E.; off Japan.

Penæus velutinus (2 ♀). | *Alpheus avarus* (1 ♀).

STATION 235. June 4, 1875; lat. 34° 7′ N., long. 138° 0′ E.; south of Japan; depth, 565 fathoms; bottom, green mud; bottom temperature, 38°·1. Trawled.

Penæus tenellus.
Benthesicymus altus (4 ♀ ♂).
Gennadas parvus (♀).
Acanthephyra sica (2 ♀ ♂).
Nematocarcinus tenuipes (6 ♂ ♀).
Notostomus japonicus (1 ♂).

STATION 236. June 5, 1875; lat. 34° 58′ N., long. 139° 29′ E.; south of Japan; depth, 775 fathoms; bottom, green mud; bottom temperature, 37°·6. Trawled.

Sergestes prehensilis (1 ♂).
Acanthephyra brachytelsonis (1 ♀).
Pasiphæa amplidens (1).
Pasiphæa acutifrons (1).

STATION 237. June 17, 1875; lat. 34° 37′ N., long. 140° 32′ E.; near Yokohama; depth, 1875 fathoms; bottom, blue mud; bottom temperature, 35°·3. Trawled.

Aristeus armatus (1 ♀).
Hepomadus glacialis (1 ♀).
Gennadas parvus (1 ♀).
Glyphocrangon rimapes (1 ♀).
Nematocarcinus proximatus (1 ♀).
Nematocarcinus productus (1 ♀).
Nematocarcinus parvidentatus (9 ♂ ♀).
Nematocarcinus longirostris (10 ♀ ♂).

Off Yokohama.

Penæus velutinus (6 ♂ ♀).
? Thalassocaris stimpsoni (1). Surface.

North-west Pacific.

Sergestes corniculum.
Eretmocaris rimapes.

West Pacific.

Sergestes semiarmis.
Lucifer typus.

North Pacific.

Sergestes edwardsii.
Lucifer typus.
Amphion reynaudii.

STATION 245. June 30, 1875; lat. 36° 23′ N., long. 174° 31′ E.; depth, 2775 fathoms; bottom, red clay; bottom temperature, 34°·9.

Hymenodora rostrata (1). In tow-net at 1700 fathoms.

STATION 246. July 2, 1875; lat. 36° 10′ N., long. 178° 0′ E.; depth, 2050 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·1. Trawled.

Aristeus armatus (1 ♂).

STATION 250. July 9, 1875; lat. 37° 49′ N., long. 166° 47′ W.; depth, 3050 fathoms; bottom, red clay; bottom temperature, 35°. Trawled.

Benthesicymus pleocanthus (2 ♂). | *Gennadas parvus* (1).

STATION 254. July 17, 1875; lat. 35° 13′ N., long. 154° 43′ W.; surface temperature, 72°. Surface.

Aristeus (young).

North Pacific; July 20, 1875.

Sergestes ancylops.

STATION 256. July 21, 1875; lat. 30° 22′ N., long. 154° 56′ W.; depth, 2950 fathoms; bottom, red clay; bottom temperature, 35°·2. Dredged.

Sergestes armatus (1).

STATION 257. July 23, 1875; lat. 27° 33′ N., long. 154° 55′ W.; surface temperature, 76°·5. Surface.

Sergestes oculatus (1).

Off the Sandwich Islands.

Sergestes parvidens. | *Lucifer* (young).
Sergestes ventridentatus. | *Lucifer reynaudii.*

North Pacific, August 21, 1875.

Sergestes oculatus.

Honolulu; fresh-water rivers.

Atya bisulcata (100 ♀ ♂). | *Bithynis grandimanus.*

Honolulu (reefs).

Alpheus lævis (1 ♂).

Off Honolulu; depth, 18 fathoms.

Alpheus prolificus (1 ♀).

North Pacific.

Sergestes præcollis. | *Sergestes ventridentatus.*
Sergestes spiniventralis. | *Sergestes utrinquedens.*
Sciacaris telsonis.

Station 267. August 28, 1875; lat. 9° 28′ N., long. 150° 49′ W.; south of the Sandwich Islands. Tow-net at 2000 fathoms.

Gennadas parvus (1).

Station 270. September 4, 1875; lat. 2° 34′ N., long. 149° 9′ W.; surface temperature, 79°·5. Surface.

Lucifer typus. | *Lucifer reynaudii.*

South Pacific, north of Low Archipelago; September 1875.

Sergestes rinkii. | *Sergestes oculatus.*
Caricyphus gibberosus.

Station 272. September 8, 1875; lat. 3° 48′ S., long. 152° 56′ W.; north of the Low Archipelago; depth, 2600 fathoms; bottom, Radiolarian ooze; bottom temperature, 35°·1. Trawled.

Benthesicymus crenatus (1 ♀).

Between Honolulu and the Low Islands, September 12, 1875.

Sergestes armatus.

Station 276. September 16, 1875; lat. 13° 28′ S., long. 149° 30′ W.; near the Low Archipelago; depth, 2350 fathoms; bottom, red clay; bottom temperature, 35°·1. Trawled.

Aristeus armatus (1 ♀). | *Benthesicymus crenatus* (2 ♀).

Station 279c. October 2, 1875; lat. 17° 29′ 11″ S., long. 149° 34′ 32″ W.; near Tahiti; depth, 680 fathoms; bottom, volcanic mud. Trawled.

Alpheus spiniger (1 ♀).

Tahiti.

Panulirus penicillatus (1). | *Bithynis lar* (5 ♂). Fresh-water.

Station 281. October 6, 1875; lat. 22° 21′ S., long. 150° 17′ W.; depth, 2385 fathoms; bottom, red clay; bottom temperature, 34°·9. Trawled.

Haliporus curvirostris (1)

South Pacific; lat. 24° S., long. 148° W.

Sergestes fermerinkii.

Station 285. October 14, 1875; lat. 32° 36′ S., long. 137° 43′ W.; depth, 2375 fathoms; bottom, red clay; bottom temperature, 35°. Trawled.

Haliporus curvirostris (1 ♀).
Benthesicymus brasiliensis (1 ♀).
Bentheocaris exuens (1).
Acanthephyra longidens (1 ♂).

Station 289. October 23, 1875; lat. 39° 41′ S., long. 131° 23′ W.; depth, 2550 fathoms; bottom, red clay; bottom temperature, 34°·8. Trawled.

Hepomadus inermis (1).
Gennadas parvus (1 ♂).

South-west Pacific.

Sergestes junceus.

Station 295. November 5, 1875; lat. 38° 7′ S., long. 94° 4′ W.; depth, 1500 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·3. Trawled.

Sergestes longicollus (1).

Station 298. November 17, 1875; lat. 34° 7′ S., long. 73° 56′ W.; depth, 2225 fathoms; bottom, blue mud; bottom temperature, 35°·6. Trawled.

Willemœsia leptodactyla (♀).

Between Valparaiso and Juan Fernandez. Tow-net at 200 fathoms.

Sergestes nasidentatus.

Station 300. December 17, 1875; lat. 33° 42′ S., long. 78° 18′ W.; off Valparaiso; depth, 1375 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·5. Trawled.

Pentacheles lævis (1 ♀).
Willemœsia leptodactyla (1 ♂).
Sergestes profundus (1).
Glyphocrangon rimapes (2 ♀).
Nematocarcinus proximatus (3 ♀).

Station 302. December 28, 1875; lat. 42° 43′ S., long. 82° 11′ W.; depth, 1450 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·6. Trawled.

Nematocarcinus proximatus (3 ♂ ♀).

Station 304. December 31, 1875; lat. 46° 53′ 15″ S., long. 75° 12′ 0″ W.; Port Otway, Patagonia; depth, 45 fathoms; bottom, green sand. Dredged.

Nothocaris spiniserratus (8).

Station 305A. January 1, 1876; lat. 47° 48′ 30″ S., long. 74° 47′ 0″ W.; Messier Channel; depth, 125 fathoms; bottom, blue mud. Trawled.

Campylonotus semistriatus (6 ♀ ♂).

Station 305B. January 1, 1876; lat. 47° 48′ S., long. 74° 46′ W.; Messier Channel; depth, 160 fathoms; bottom, blue mud. Trawled.

Stereomastis suhmi.

Station 306A. January 2, 1876; lat. 48° 27′ S., lat. 74° 30′ W.; Messier Channel; depth, 345 fathoms; bottom, blue mud; bottom temperature, 46°. Trawled.

Campylonotus semistriatus (3 ♂).

Station 307. January 4, 1876; lat. 49° 24′ 30″ S., long. 74° 23′ 30″ W.; off Port Grappler; depth, 140 fathoms; bottom, blue mud. Trawled.

Campylonotus semistriatus (40 ♀ ♂).

Station 308. January 5, 1876; lat. 50° 8′ 30″ S., long. 74° 41′ 0″ W.; off Tom Bay; depth, 175 fathoms; bottom, blue mud. Trawled.

Campylonotus semistriatus (9 ♀ ♂). | *Campylonotus vagans* (1 ♀).

Station 309. January 8, 1876; lat. 50° 56′ S., long. 74° 15′ W.; Puerto Bueno; depth, 40 fathoms; bottom, blue mud; bottom temperature, 47°.

Campylonotus semistriatus (3 ♀).

Station 310. January 10, 1876; lat. 51° 27′ 30″ S., long. 74° 3′ 0″ W.; Sarmiento Channel; depth, 400 fathoms; bottom, blue mud; bottom temperature, 46°·5. Trawled.

Acanthephyra carinata (1 ♂). | *Acanthephyra approxima* (1).

Campylonotus semistriatus (6 ♀ ♂).

STATION 311. January 11, 1876; lat. 52° 45′ 30″ S., long. 73° 46′ 0″ W.; off Port Churruca; depth, 245 fathoms; bottom, blue mud; bottom temperature, 46°. Trawled.

Stereomastis suhmi (9). | *Campylonotus semistriatus* (4 ♀ ♂).
Pasiphæa acutifrons (1).

STATION 315. January 26, 1876; lat. 51° 40′ S., long. 57° 50′ W.; Port William; depth, 12 fathoms; bottom, sand, gravel. Dredged.

Nauticaris marionis (1 ♂).

STATION 318. February 11, 1876; lat. 42° 32′ S., long. 56° 29′ W.; depth, 2040 fathoms; bottom, blue mud; bottom temperature, 33°·7. Trawled.

Acanthephyra sica (1). | *Acanthephyra brachytelsonis* (4 ♀ ♂).
Hymenodora mollicutis (1 ♀).

STATION 320. February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; off Monte Video; depth, 600 fathoms; bottom, green sand; bottom temperature, 37°·2. Trawled.

Sergestes atlanticus (1). | *Pandalopsis amplus* (6 ♂ ♀).

STATION 321. February 25, 1876; lat. 35° 2′ S., long. 55° 15′ W.; off Monte Video; depth, 13 fathoms; bottom, mud. Trawled.

Pleoticus mulleri (30 ♂). | *Artemesia longinaris* (39 ♀ ♂).

STATION 323. February 28, 1876; lat. 35° 39′ S., long. 50° 47′ W.; off Buenos Ayres; depth, 1900 fathoms; bottom, blue mud; bottom temperature, 33°·1. Trawled.

Aristeus armatus (1 ♂). | *Benthesicymus brasiliensis* (4 ♀ ♂).

STATION 325. March 2, 1876; lat. 36° 44′ S., long. 46° 16′ W.; depth, 2650 fathoms; bottom, blue mud; bottom temperature, 32°·7. Trawled.

Hemipenæus speciosus (♂ ♀ 2).

STATION 331. March 9, 1876; lat. 37° 47′ S., long. 30° 20′ W.; depth, 1715 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·4. Trawled.

Glyphocrangon rimapes (1 ♀).

Station 347. April 7, 1876; lat. 0° 15′ S., long. 14° 25′ W.; surface temperature, 82°. Surface.

Sergestes diapontius.

North Atlantic, April 1876. Surface.

Sergestes longirostris.

Station 352. April 13, 1876; lat. 10° 55′ N., long. 17° 46′ W.; surface temperature, 77°·7. Surface.

Platysaccus crenatus.

Station 354. May 6, 1876; lat. 32° 41′ N., long. 36° 6′ W.; depth, 1675 fathoms; surface temperature, 70°. Surface.

Sergestes atlanticus (1).
Sergestes longispinus.
Sergestes semiarmis (1).
Acanthephyra purpurea (1 ♀).

BATHYMETRICAL DISTRIBUTION.

TABLE SHOWING THE DEPTH IN FATHOMS AT WHICH THE SPECIES OF EACH GENUS WERE OBTAINED.

	0 to 50.	50 to 100.	100 to 500.	500 to 1000.	1000 to 2000.	2000 to 3000.	3000 to 4000.
Trichobranchiata.							
Aberrantia.							
Pylochelidæ.							
Cheiroplatea, . .	.	.	1				
Thalassinidæ.							
Thalassina, . .	1						
Callianassidæ.							
Callianassa, . .	.	.	1				
Cheramus, . .	1	.	1				
Scallasis, . . .	1						
Axiidæ.							
Paraxius, . .	.	.	.	.	1		
Eiconaxius, . .	.	.	1	2			
Thaumastochelidæ.							
Thaumastocheles, . .	.	.	1				
Normalia.							
Synaxidea.							
Scyllaridæ.							
Ibaccus, . . .	1	.	3				
Thenus, . . .	1						
Arctus, . . .	1	2	1				
Palinuridæ.							
Panulirus, . .	1	.	1				
Palinosytus, . .	1	.	1				
Phyllosoma, . .	3						
Eryonidæ.							
Eryoneicus, . .	.	.	.	.	1		
Polycheles, . .	.	.	2	1	1		
Pentacheles, . .	.	.	1	3	2		
Stereomastis, . .	.	.	1	1			
Willemœsia, . .	.	.	.	.	1	1	
Homaridæ.							
Phoberus, . .	.	.	.	1			
Nephropsis, . .	.	.	.	2			
Nephrops, . .	.	1	1				
Astacidæ.							
Astacopsis, .	3 (fresh-water)						

	0 to 50.	50 to 100.	100 to 500.	500 to 1000.	1000 to 2000.	2000 to 3000.	3000 to 4000.
Stenopidæ.							
Stenopus, . . .	1						
Spongicola, . .	.	1					
Dendrobranchiata.							
Normalia.							
Penæidea.							
Penæidæ.							
Penæus, . . .	10	3	4	.	2	1	
Pleoticus, . .	2	.	1				
Artemesia, . .	1						
Haliporus, . .	.	.	2	2	1	2	
Sicyonia, . . .	2	.	1				
Hemipenæus, . .	.	.	3	2	1	2	
Aristeus, . . .	.	.	1	.	1	1	
Hepomadus, . .	.	.	.	.	1	1	
Peteinura, . .	1						
Benthesicymus, . .	.	.	2	1	5	2	1
Gennadas, . .	1	.	1	1	2	1	1
Sergestidæ.							
Petalidium, . .	.	.	.	.	1	1	
Sergestes, . . .	27	.	3	4	1	2	
Elaphocaris, . .	1						
Platysaccus, . .	1						
Acanthosoma, . .	5						
Mastigopus, . .	5						
Sciacaris, . . .	2						
Lucifer, . . .	2	1					
Phyllobranchiata.							
Aberrantia.							
Zoontocaris, . .	2						
Sestertius, . . .	1						
Normalia.							
Crangonidea.							
Crangonidæ.							
Crangon, . . .	2						
Pontophilus, . .	.	.	1	.	1	2	
Sabinea, . . .	.	1					
Pontocaris, . .	1	.	1				
Polycarpidea.							
Nikidæ.							
Glyphocrangon, . .	.	.	2	2	4		
Nika, ...	1						
Alpheidæ.							
Athanas, . . .	1						
Parathanas, . .	1	1					
Cheirothrix, . .	1						
Alpheus, . . .	16	2	.	.	.	1 (?)	
Betæus, . . .	2						
Paralpheus, . .	1						
Synalpheus, . .	1						
Hippolytidæ.							
Platybema, . .	.	.	.	1			
Latreutes, . . .	3						

	0 to 50.	50 to 100.	100 to 500.	500 to 1000.	1000 to 2000.	2000 to 3000.	3000 to 4000.
Hippolytidæ—*continued.*							
Hippolyte,	1	1					
Spirontocaris,	.	1					
Nauticaris,	2	2	1				
Hetairus,	.	3					
Chorismus,	.	.	1				
Merhippolyte,	.	.	1	1			
Amphiplectus,	.	.	1				
Pandalidæ.							
Heterocarpus,	.	.	4	1			
Plesionika,	.	.	5	1	1		
Nothocaris,	2	1	2				
Pandalus,	.	1	2				
Pandalopsis,	.	.	.	1			
Chlorotocus,	.	.	1				
Dorodotes,	1	.	.	.	1		
Monocarpidea.							
Thalassocaridæ.							
Thalassocaris,	1						
Diaphoropus,	2						
Kyptocaris,	1						
Atyidæ.							
Atya,	3						
Caridina,	1						
Pontoniidæ.							
Pontonia,	(?) 1						
Caricyphidæ.							
Caricyphus,	5						
Rhomaleocaris,	1						
Anebocaris,	1						
Acanthephyridæ.							
Bentheocaris,	.	.	.	.	1	1	
Acanthephyra,	.	.	7	5	4	6	
Systellaspis,	.	.	1				
Oplophorus,	.	.	.	3	1		
Campylonotus,	1	.	3				
Palæmonidæ.							
Palæmon,	2						
Palæmonella,	.	.	1				
Bithynis,	2 (fresh-water)						
Brachycarpus,	2						
Nematocarcinidæ.							
Nematocarcinus,	1	.	2	7	7	1	
Stochasmus,	.	.	.	.	1		
Tropiocaridæ.							
Notostomus,	.	.	.	2	2	2	
Tropiocaris,	.	.	.	.	1	1	
Hymenodora,	.	.	.	1	3	3	
Stylodactylidæ.							
Stylodactylus,	.	.	1	2			
Pasiphæidæ.							
Leptochela,	3						

	0 to 50.	50 to 100.	100 to 500.	500 to 1000.	1000 to 2000.	2000 to 3000.	3000 to 4000.
Pasiphæidæ—*continued.*							
Pasiphæa, . .	.	.	2	2			
Orphania, . .	.	.	.	.	1		
Oodeopidæ.							
Oodeopus, . . .	7						
Haplopodea.							
Hectarthropidæ.							
Procletes, . . .	.	.		1			
Icotopus, . . .	1						
Hectarthropus, . .	4						
Eretmocaris, . .	4						
Amphion, . .	2						

GENERAL OBSERVATIONS.

The classification of the Macrura into three separate divisions, according to the structural character of one of their most important and essential organs, will be found convenient in the study of this order in relation to its distribution both in time and space.

Each division is apparently of equal importance both in relation to size and structure, but however much they may correspond in certain anatomical details which are characteristic of the separate divisions, or may approximate to one another in general form, yet they are essentially distinct in affinity, both in their development and descent. Independent of the character of the branchiæ, the Trichobranchiata, Dendrobranchiata, and Phyllobranchiata are separated generally from each other by the form of the carapace, the appendages of the pereion, the plan of the rhipidura, and the stage at which the embryo quits the ovum.

In the Dendrobranchiata the brephalos is supposed to exist in the Nauplius condition, from positive evidence in the genus *Lucifer;* and from negative evidence of all the other genera this is supposed to obtain universally throughout the division.

In the Phyllobranchiata the brephalos, so far as it has been observed, is a Zoea, excepting in the case of a few genera in which closely allied forms vary, such as *Alpheus* and *Homaralpheus*, *Acanthephyra* and *Systellaspis*, and *Crangon*, in which it appears that the only separation beyond specific character is that of this variation in the stage of the brephalos.

In the Trichobranchiata the brephalos is in the Megalopa condition, of which *Phyllosoma* is an immature stage; this is universal in the division, excepting in the genus *Stenopus*. According to their branchial structure both *Stenopus* and *Spongicola* belong to the Trichobranchiata, while the appearance of their carapace resembles that of the Phyllobranchiata, and the structure of their legs corresponds with that of the Dendrobranchiata; whereas in the manner of their development, the brephalos of *Stenopus* appears to be a Megalopa, approaching in form that of the Trichobranchiata, while that of *Spongicola* is a Zoea, approaching that of the Phyllobranchiata.

In the Dendrobranchiata *Lucifer* is the only genus the development of which has been accurately determined, although the negative evidence arising from the absence of the attachment of ova in all known genera is suggestive of their being fertilised as in *Lucifer*, and hatched also in the Nauplius stage.

In the Phyllobranchiata the brephalos quits the ovum as a Zoea, but to this rule there are exceptions, and these may exist in nearly allied species, as in *Alpheus* and *Homaralpheus*, which are generically separated on the physiological grounds that *Alpheus* has the brephalos hatched in the form of a Zoea and *Homaralpheus* in the form of a Megalopa. Similar reasons suggested the separation of *Systellaspis* from *Acanthephyra* and *Crangon arctus* from *Crangon vulgaris*. Now if we turn to the genus *Oplophorus*, which Milne-Edwards has ranged among the Penæidea—chiefly it appears from its having a series of large basecphyses attached to the legs—there is nothing in its general form excepting the non-chelate character of the third pair of pereiopoda which prevents it from being considered a long-spined congener of *Sicyonia*,

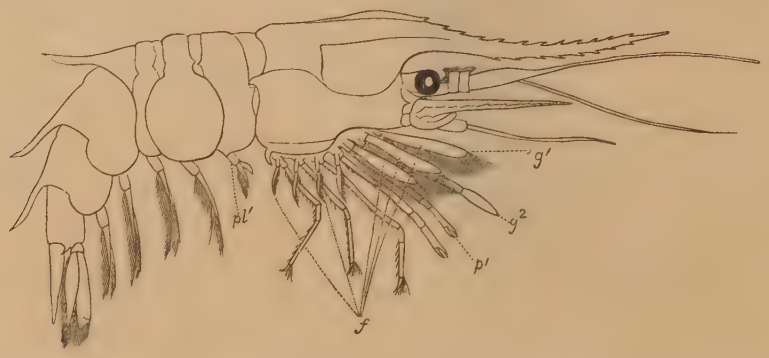

FIG. XVI.—*Oplophorus typus*, from a drawing by the late Dr. R. von Willemoes Suhm. *g'*, first gnathopod; *g²*, second gnathopod; *p'*, first pereiopod; *f*, basecphyses; *pl'*, first pleopod.

which it approximately resembles, yet we know that they differ in the manner of their development and in the structure of their respiratory organs, and therefore are widely separated in their genealogical history.

If therefore we utilise our observations on the external form of these recent Crustacea we may be able to read much of their internal structure and organisation, and determine the true relation of the fossil forms to their recent congeners. And I believe that I am near to the truth in asserting that nearly all, if not all, the Macrurous forms that are found in the earliest geological formations belong to the Trichobranchiata, either Normal or Aberrant.

There are some genera which have only been deciphered from such very distorted or injured fragments that it is impossible as yet to determine their perfect structure; such is the case with *Palæocrangon* (?) *socialis*, Salter, and of *Gilocrangon*, Ritchie, of which

Mr. Salter says—"It is, I should think, doubtful, judging by the figures, if it be a crustacean at all."[1]

The genus *Palæocarabus*—of which the species *Palæocarabus russellianus*, being the best preserved, may be accepted as the type—is very near the Astacidea with its short and stunted scaphocerite; but *Anthrapalæmon*, of which the species *Anthrapalæmon frosartii* appears to be the most perfect in preservation, has no scaphocerite, nor can this be due to its want of preservation, inasmuch as the peduncle of the second antennæ is well preserved and minutely figured by the late Mr. J. W. Salter.[2]

Among the specimens of the Challenger collection, I found in one of the bottles a dismembered specimen of a deep-sea genus belonging to the Galatheidæ, that so closely resembled the fossil *Anthrapalæmon* that it might I think be accepted as belonging to the same genus. The fossil specimen is recorded from the "slaty band" of the black-band ironstone of the Carboniferous limestone of Lanarkshire. The genus *Pemphix*, von Meyer, appears to possess all the characters of a Galathæan; while the genera *Glyphæa* and *Scapheus* approach the Callianassidæ, to which family the genus *Megacherus* appears also to belong.

The genus *Clytia*, as restored by Reuss, except for the accidental additions of a somite too many to the pleon, is suggestive of the genus *Phoberus*, A. Milne-Edwards, in which the appendages are a little more robust than is seen in the Challenger species, *Phoberus tenuimanus;* and the genus *Thaumastocheles* has its prototype in the recently discovered *Stenocheles* of the Chalk formation of Bavaria.

Münster's species of *Palinurella pygmæa* from the White Jura bears a near resemblance to a young specimen of *Palinurus* of the recent seas, of which the common Rock or Spiny Lobster (*Palinurus vulgaris*) may be considered as the type. It is generally called the "Crawfish" by the Cornish fishermen, and is very plentiful all round the shores of Europe, being very abundant at the entrance to the English Channel. It appears to be essentially a northern and southern form. It is represented in the South Indian Ocean by *Palinurus edwardsii*, which ranges from the Cape of Good Hope to New Zealand, by *Palinurus trigonus* in Japan, *Palinurus frontalis* on the coast of South America, and by *Palinurus longimanus* from the Antilles. Besides these species which are only separated from each other by small differences that have only been appreciated by the minute observations of modern research, there are a large number of allied forms, which are more widely separated in organisation, but which may readily be determined by having the flagella attached to the first pair of antennæ very much longer and more slender than in those already referred to. These were placed by the late Dr. Gray of the British Museum under the generic name of *Panulirus*.

[1] *Quart. Journ. Geol. Soc.*, vol. xvii. p. 533, 1861.
[2] *Quart. Journ. Geol. Soc.*, vol. xvii. p. 531, figs. 1, 2, 1861.

The localities of this latter genus appear to be more numerous within the warmer or tropical latitudes, as may be seen from the accompanying table :—

Panulirus americanus, Lamarck,	Antilles.
„ *dazipus*, Latreille,	India.
„ *dugessii*, de Haan,	Japan.
„ *fasciatus* (Fabricius),	Indian Ocean.
„ *guttatus*, Latreille,	Antilles.
„ *interruptus*, Randall,	California.
„ *japonicus* (de Haan),	Japan.
„ *longipes*, A. Milne-Edwards,	Antilles.
„ *ornatus* (Milne-Edwards),	Hong-Kong.
„ *penicillatus*, Milne-Edwards,	Tahiti.
„ *speciosus*, Milne-Edwards,	Pacific.
„ *sulcatus* (Lamarck),	India.

Of these localities, Japan, that is about 40° N. lat., is the most northerly range, whereas the species of *Palinurus* in which the flagella of the first pair of antennæ are short have been taken, with the exception of the little known species *Palinurus longimanus*, south of the Cape of Good Hope or north of the latitude of the Japanese Islands.

In passing to a consideration of the closely allied genera of Scyllaridæ it is necessary to notice the ancient form of *Cancrinos claviger*, Münster, found in the White Jura of Bavaria, which possesses much of the character of the Scyllaridæ, but has the outer pair of antennæ multiarticulate as in the Palinuridæ, but reduced in length to about that of the carapace, and has the flagellum increased in diameter to a greater degree than that of the peduncle, as if it were in anticipation of assuming the broad flat uniarticulate condition of the Scyllaridæ. The body of the animal itself is apparently broader and more depressed dorsally than in the Palinuridæ. This genus leads us on to the Scyllaridæ, of which the earliest form appears to have been found in *Thenops scyllariformis*, Bell, of the London Clay.

This family in the recent seas is remarkable for the broad and foliaceous character of the flagellum of the second pair of antennæ, which, instead of being multiarticulate, consists of a broad and uniarticulate disc-like plate.

Most of our recent species are inhabitants of the warmer zones. *Ibaccus peronii* has been taken as far south as Australia, but all the other species appear to be inhabitants of the tropical regions. One species of the genus *Scyllarus* has been taken as far north as Japan, or in latitude 40°, and the closely allied form *Arctus* has been found as far north as lat. 50°, it being common on the French coast, and on the islands at the entrance to the English Channel, and it has occasionally been found as far north as the shore of Cornwall and Devon, and sometimes has even been taken in Plymouth Sound.

The general distribution is shown in the following table :—

Ibaccus brevipes,	New Guinea.
„ *pares*,	Antilles.
„ *peronii*,	Australia.
„ *verdi*,	Cape Verde Islands.
Thenus orientalis,	Seychelles Islands and the Indian Ocean.
Arctus immaturus,	Cape Verde Islands.
„ *orientalis*,	Philippine Islands.
„ *pygmæus*,	Canary Islands.
„ *rugosus*,	India.
„ *sordidus*,	Hong Kong.
„ *tuberculatus*,	New Guinea.
„ *ursus*,	Europe.
Scyllarus æquinoctialis,	Antilles.
„ *latus*,	Canary Islands.
„ *sculptus*,	
„ *squamosus*,	Antilles.

Numerous species of the genus *Eryon* have been found in the Lias of England, Normandy, and the Upper White Jura of Bavaria. This family is numerously represented in our recent fauna, the whole of the species being inhabitants of the deeper parts of the ocean ; generally preferring to dwell where the bottom is mostly covered by Globigerina ooze, excepting in the case of the genus *Stereomastis*, which lives on a muddy bottom in the narrow channels between the mainland and the numerous islands on the western coast of Patagonia, at a depth of 200 to 600 fathoms. Species of the recent genus *Willemœsia* are to be found in Mid, North, and South Atlantic, as well as in Mid Pacific, at a depth of about 2000 fathoms, while *Pentacheles* and *Polycheles* are met with at from 100 to 1000 fathoms in channels among the Polynesian Islands, as well as in the West Indies, whilst another representative form, *Eryoneicus*, exists among the Cape Verde Islands.

The genus *Hoploparia* of the Green Sand and London Clay, appears to be represented in our recent Homaridæ ; so much so that *Hoploparia longimana* from Lyme Regis corresponds so closely with *Nephropsis rosea* as to appear to be only a smoothly rostrated species of the same genus, and both bear a near resemblance to a young *Homarus*, from which they differ in having no scaphocerite and smaller ophthalmopoda.

Different species of *Nephropsis* have been found in the North Atlantic, the West Indies, the South Atlantic, and the Celebes Seas, all of which possess the remarkable feature in common with the fossil form of having no scaphocerite, and the ophthalmopoda are also reduced to a rudimentary condition.

The consideration of these species gradually leads to that of another family of no very different structural character, but with very distinct surroundings. Instead of inhabiting the deeper recesses of the sea, the group Astacidea inhabits the fresh-water

streams and lakes of the continents and larger islands of both the northern and southern hemispheres.

The northern genera differ in the number of their branchiæ from those of the southern, which also exhibit evidence of a divergence in descent.

Those of Europe and America possess evidence of a closer consanguinity, but are generically separated by the numerical distinction of the branchial plumes; whilst those of Eastern Europe and Western Asia differ only in specific value very considerably from those of Western Europe, those of Eastern Europe differ in external form but slightly from those of Eastern America.

Those that inhabit the rivers of South America differ in external appearance from those of the northern continent, but bear a corresponding resemblance to those that inhabit the rivers of Australia, while these latter differ widely both in appearance and structure from the New Zealand forms. The solitary species of the only genus of Madagascar differs structurally from, but corresponds externally with, those that belong to Australia.

In all the northern forms the outer margin of the dactylos is either straight or incurved, whereas in the southern genera the same part is always arched or curved outwards. It is but a small distinction, but it is one that is invariably capable of determining the northern from the southern species, and it is interesting to notice that a fossil species was recently found in the Eocene formation of North America that possesses this congenital feature peculiar to the northern forms; a circumstance that demonstrates the long and persistent character in the history of this feature.

The several species have been arranged in accordance with their general form and the number of their branchiæ into the following genera :—

Astacus in Europe and Asia.
Astacoides in Madagascar.
Astacopsis in Australia.
Cambarus in North and East America.
Cherops in Tasmania.
Engæus in Tasmania.
Paranephrops in New Zealand.
Parastacus in Australia and South America.

In looking back through past ages it would appear that the earliest macrurous forms are those that have been obtained from the coal measures of Shropshire and Glasgow, and if the illustrations given be anatomically correct, the structure of *Palæocarabus* corresponds with a Crustacean that belongs to the Trichobranchiata. The short and stunted form of the scaphocerite of the second pair of antennæ is such as is seen to exist in the Astacidea of recent periods, but the restoration of the specimen of *Palæocarabus russellianus*, as given in Salter's paper,[1] shows that the rostrum is long and laterally compressed, contrary to its character in the Astacidea, or in fact in any of the Trichobranchiata, excepting those of the family Stenopidæ.

[1] *Quart. Journ. Geol. Soc.*, vol. xix. p. 520, figs. 1, 2.

The Dendrobranchiata have a few representatives in the ancient seas. *Penæus speciosus*, Münster, from the White Jura of Bavaria, is closely allied to the recent deep-sea genus *Gennadas;* and *Dusa monocera* bears a miniature resemblance to *Penæus monodon* of the Indian Ocean. The form of *Aeger* as restored in Salter and Woodward's Chart of Fossil Crustacea is evidently supposed by them to be of the same genus, and *Blaculea sieboldi* may belong to *Penæus* also.

The recent genera that belong to this division, with the exception of the Sergestidæ, are mostly pelagic in their habits. In Japan the species *Peñæus canaliculatus* is of considerable size and is used as an article of food, a circumstance that would argue for its frequenting water sufficiently shallow to be within the reach of ordinary fishermen, but, in the record given, it is probable that many specimens are those of wanderers from the deeper waters of their ordinary localities. Only one specimen of *Gennadas* is stated to have been captured within 50 fathoms of the surface, while others have been taken beyond 3000 fathoms, and it is this deep-sea species that corresponds most nearly with *Penæus speciosus*, Münster; while *Dusa monoceros* of the same geological horizon bears a tolerable resemblance to *Penæus monodon*, which is an inhabitant of less than 30 fathoms. With the exception of a few species, such as *Petalidium*, that have been dredged, almost all the Sergestidæ have been taken within 50 fathoms of the surface, and none of these have been recorded as having been found in a fossil condition.

The division Phyllobranchiata is still more feebly represented. *Tropifer lævis*, Gould,[1] appears to me to approximate more nearly to the genus *Pontocaris* of the Crangonidæ than, as supposed by the author, to the genus *Nephrops* or *Scyllarus*, in consequence of the lateral position of the ophthalmopoda. The absence of any rostrum, and the presence of the ophthalmopoda as short and spherical bodies at the outer angles of the frontal margin of the carapace, bear comparison with *Pontocaris*, the carapace of which is longitudinally traversed by carina, and transversely divided by a cervical fossa. In the fossil specimen the ophthalmopoda are at the extreme fronto-lateral angles of the carapace, while in *Pontocaris pinnata* (Pl. XCI. fig. 1) the fronto-lateral angles project on the outer side of them, but in the younger forms of Crustacea the ophthalmopoda are more in accordance with the condition seen in the fossil specimen.

Urodella agassizii, Oppel, from the Upper White Jura of Bavaria, may find its congener in the genus *Crangon* of recent times, but the pereiopoda are not sufficiently figured in clear detail for a fixed opinion to be given.

The common Shrimp that so abundantly frequents the shores of Europe, lives generally where the sand is fine and most abundant. They swim about in the shallow water that precedes the incoming tidal wave, or when at rest sink to the bottom and partially bury themselves in the sand, first by wriggling out a depression with their legs and bodies,

[1] *Proc. Zool. Soc. Lond.*, vol. xiii. p. 360, fig. 1.

and then by dragging the sand over their backs by the aid of their long antennæ until they are covered, all but their eyes, which appear above the sand, and suit well the tint of their surroundings. The speckled grey of their surface is common to all the specimens that dwell in shallow water, but often migrants may be found in deeper water, in which the change of colour at first provokes the belief in a distinction of more importance, since with the loss of the speckled appearance they also possess a more slender form, that may be induced through an increase of restless activity in a search for food and from the lessened necessity for hiding from passing dangers.

On the Japanese coast, in the narrow channels that separate the islands, specimens have been taken at from 10 to 12 fathoms, that so closely resemble our European species that we are not able to determine any constant feature of distinction; and in fact the Japanese species more closely resemble those of the shallow waters of our bays than do the specimens taken from deeper water in the same locality.

Not only do we find our common Shrimp, *Crangon vulgaris*, in the seas of Japan, but we also meet with it on the eastern coast of North America, whilst on the western shores as far south as Mexico there is found a species that Dr. Stimpson named *Crangon nigricauda* from its having the sixth somite of the pleon black in colour, but most other observers agree, from a close analytical examination, that it is not distinct from our European species.

Thus it would appear that this familiar form may be found common perhaps to all the sandy shores of the entire northern hemisphere.

According to the observation of specimens brought home by the Challenger the several species of *Nematocarcinus* only differ from one another in the relative length of the projecting rostrum, the numerical value of their dental ornamentation, and the comparative length of their legs, which are found to extend over a considerable space.

The species extend geographically from the line of the southern icy sea-board to the latitude of Japan in the northern hemisphere, and along the line of the Australasian Archipelago from Celebes to the Kermadec Islands, to which I may add that they have been taken in the West Indies by the "Blake" Expedition, and in the Atlantic during the cruise of the "Travailleur."

In all the habitats recorded, the sea-bottom consists of a Diatomaceous or Globigerina ooze, with the exception of the neighbourhood of the Kermadec Islands, where it is recorded as being rocky, although at a short distance off the island a muddy bottom exists.

In the track from south to north, that is from the South Indian Ocean, a great line of current has its course over the area occupied by these animals, running up the eastern coast of Australia, and turning westward among the islands of the Archipelago of New Guinea, Celebes, and the Philippine Islands, turning northward and travelling along the eastern shores of Asia, till it sweeps eastward along the shore of Japan.

These long-legged Prawns (*Nematocarcinus*) are essentially free-swimming forms, that probably pass their lives in mid-water, at an average depth of 1000 fathoms. The largest number of specimens at the largest number of stations have been taken between 500 and 2000 fathoms, while at one station there were fifteen specimens taken at 28 fathoms in the shallow waters of the Arafura Sea. In every instance of their capture the trawl was used, although in some instances the dredge was employed also, and it is probable that they only occasionally come into contact with the sea-bottom, and the greatest depth at which they have been taken is 2150 fathoms off the Celebes Islands, or about two miles from the surface. The second deepest range is south of Japan, at a depth of 1875 fathoms, or about one mile and one-eighth. Off Juan Fernandez in the Pacific, specimens were taken at two stations at an average depth of one mile.

In this genus there are several species which depart from each other in characters apparently so unimportant that it is difficult to fix on any salient points of sufficient importance to determine specific features. Thus *Nematocarcinus longicarpus*, *Nematocarcinus parvidentatus*, *Nematocarcinus paucidentatus*, and *Nematocarcinus serratus* are chiefly determinable by the form and number of the teeth on the rostrum, which bear a relation to one another as to number and position on the upper and lower margin, as shown below :—

Nematocarcinus parvidentatus,	Japan,		$\frac{24}{0}$
„ *paucidentatus*,	Fiji,		$\frac{9}{1}$
„ *serratus*,	New Zealand,		$\frac{30}{0}$
„ *tenuipes*,	Japan, Admiralty Islands,		$\frac{20}{1}$

Again, if we turn to another group which is remarkable for having a long rostrum, and for being larger when adult, we find that the external variations are but small and apparently unimportant beyond the numerical value of the teeth on the rostrum, which may be tabulated as follows :—

Nematocarcinus altus,	Philippines,		$\frac{15}{2}$
„ *lanceopes*,	Antarctic,		$\frac{26}{8}$
„ *longirostris*,	Japan,		$\frac{40}{5}$
„ *proximatus*,	Marion Island, Valparaiso, Arafura Sea, Japan,		$\frac{34}{1}$

These four species have been taken at very distant localities. *Nematocarcinus longirostris* was found only on the south coast of Japan, *Nematocarcinus altus* only near the island of Celebes, and *Nematocarcinus proximatus* at two stations off the western

coast of South America, also off Marion Island in the South Indian Ocean, in the Arafura Sea, and near Japan.

It appears to me difficult to believe that these are not merely variations of one and the same species, and that if they were compelled to reside under similar local conditions, the unimportant specific distinctions would be bridged by many intermediate forms.

Although separated widely in space the conditions under which these species exist may in some respects approximate to each other. Thus the temperature at which they have severally been recorded to live off Japan and the western coast of South America do not differ widely, being 41°·1 in the former and 35°·5 in the latter. Although *Nematocarcinus altus* was taken at a still greater depth off the north-west coast of the island of Celebes, and near to land, at a depth of 2150 fathoms, with a temperature of 38°·9, that is at a temperature that is more commonly recorded at the depth of 600 fathoms.

If we compare the specific characters of one group with those of the other, we shall find but little difference beyond the number of teeth on the rostrum. Closer examination with others will show that these teeth are generally smaller and more crowded in the first and less so in the second where the rostral process is longer.

All these distinctions are but slight in relation to the physical conditions which appear to lead to the true features of specific character.

No specimen of this genus has so far as we know been found fossil.

The fresh-water genus *Atya* is very remarkable, both for its peculiarity of form and for the distant localities in which it has been found.

The American naturalist Randal described a small specimen which was taken in the rivers or ponds of the island of Hawaii, under the name of *Atyoida*, and another species, but very closely resembling it, was taken by the late Dr. Stimpson in the island of Tahiti, whence numerous specimens were brought home in the Challenger collection. A third has been taken in the rivers of Mexico by Saussure, and, lastly, from the river Potimerim in South America.

The older known species that have longer been associated with the genus are eight in number, and are found in localities here tabulated:—

Atya armata,	New Zealand.
„ *margaritacea*,	New Caledonia.
„ *occidentalis*,	Mexico and West Indies.
„ *pipilles*,	New Zealand.
„ *robusta*,	New Caledonia.
„ *scabra*,	Mexico and West Indies.
„ *spinipes*,	New Zealand.
„ *sulcatipes*,	Cape Verde Islands

Associated with *Atya sulcatipes* was a specimen of *Atya* (*Atyoida*) *serrata*, and a

damaged specimen of what I have described as *Caridina typus*, Milne-Edwards, but which I am much inclined to think from its immature condition is the young of the *Atya sulcatipes* that exists in the same locality.

In form these animals have a very peculiar feature in the articulation of the heavy chelate joint of the first two pairs of pereiopoda, which has been described at pp. 6 and 7 of this Report and by Dr. Fritz Müller.[1] When the hand is opened, according to Fritz Müller, the hairs upon the margin of the fingers spread like a fan, gather and retain fine mud; when the hand is closed these hairs close round the mud and compress it into a pellet which is passed into the mouth, and so the animal lives on the small organic substances that exist in the mud, which it collects with great rapidity.

These animals, of which the male is smaller than the female, as is frequently the case when they are not provided with offensive weapons, are only known to inhabit fresh water, and singular to relate, although they are inhabitants of distant localities, several of which are oceanic islands, yet all the species bear so close an affinity of form that it is difficult to determine one from the other by any permanent character.

The question naturally arises how, so far asunder as the habitats of these animals are, can they be brought to live without any intermediate connecting influence as far as we can determine?

Mr. Darwin, in his book on Earthworms, says that in every bit of land or distant island worms are found in the soil; considering that they are land and air-breathing animals, it is a matter of curious interest to determine how they get where they are.

M. A. Certes, in the Comptes rendus, says that having taken carefully collected sediment from which he evaporated the water, he three years afterwards treated the residue with boiled and filtered rain-water. All care having been taken to keep out germs from the air, after two months a *Nauplius*-like form was detected which later on took the form of *Artemia salina*. M. Certes points out that in cases of this kind death was only apparent, and that organic conditions and nutritive changes do not cease entirely. Thus it appears that it is quite possible for wading birds to be the means of carrying mud containing either animals or ova to a considerable distance and so transferring species to a great distance from one locality to another.

One of the most abundant in specific forms is the genus *Alpheus*, including those subgenera that are separated more for the convenience of classification than from any distinguishing point of more than specific value, *Paralpheus*, *Synalpheus*, *Cheirothryx*, and *Betæus*. These contain about eighty different species, and with the exception of a single instance they have all been taken within 52 fathoms from the surface. They are mostly recorded from muddy bottoms, but they are frequently found sheltered among Corallines and masses of Sponges. From their frequently being found in ooze and muddy bottoms I am inclined to believe that they burrow more decidedly than is the

[1] *Kosmos*, vol. ix. pp. 117–124, 1881.

habit of our common Shrimp, for which purpose the ophthalmopods have become protected by the frontal margin of the carapace.

They are mostly inhabitants of the warmer seas, abounding in tropical and subtropical regions, becoming scarce in the temperate, and gradually disappearing towards the subarctic regions. One specimen alone of *Betæus truncatus* is recorded by Dana from Cape Horn, where it was dredged in 10 fathoms of water, with which exception none of the family has been observed further south than New Zealand (50° S. lat.), or further north than the English Channel (52° N. lat.).

It is essentially a sublittoral form, for the instances of its being found beyond 20 fathoms are few, and these are suggestive of doubt, inasmuch as *Alpheus avarus* is recorded in our collection as being taken off Tongatabu at a depth of 18 fathoms, and in Mid-Pacific at 2675 fathoms, south of Japan.

I am not aware that any species of this or the allied genera has been found fossil.

The family of the Pasiphæidæ is but poorly represented in the Challenger collection, there being only three genera, *Pasiphæa*, *Orphania*, which are deep-sea forms, and *Leptochela*, which, if found at the bottom, lives within 50 fathoms of the surface. It is interesting to compare these species with a fossil form that has been much discussed among geologists, but it appears to me that if the interpretation of *Pygocephalus huxleyi* of Woodward[1] be correct, there can be little doubt that it is closely allied to the genus *Pasiphæa*, and that it differs from *Pasiphæa cristata* (Pl. CXLI. fig. 1) in little that cannot be considered as of merely specific importance.

[1] *Trans. Geol. Soc. Glasgow*, vol. ii. fig. 2, p. 243.

DESCRIPTIONS OF GENERA AND SPECIES.

Suborder **MACRURA.**

This section of the order Decapoda in the Crustacea may be generally defined by the following external characters :—

The animal is elongated and compressed. The carapace is less than half the length of the animal, and is anteriorly produced in the median line and covers the ophthalmic somite.

The ophthalmopoda are not enclosed within orbits, and rest in a hollow in the upper surface of the first joint of the peduncle of the antennæ.

The first pair of antennæ is elongated, and not planted in fossettes.

The second pair is considerably elongated, and carries a foliaceous appendage attached to the second joint.

The second pair of gnathopoda is elongated and pediform.

The pereiopoda have seven distinct joints, of which the coxa articulates with the pereion.

The pleopoda consist of biramose appendages, of which the anterior pair varies from the succeeding, and the posterior is associated with the telson and helps to form the great caudal fan or rhipidura, which is the only feature that is invariably constant and common to all families of the suborder.

Variations both in the structure and in the relative importance of parts occur in most organs, in some to a considerable extent, but the passage from one modification to another clearly demonstrates that such changes are of specific or generic value only. This is well shown in some species of *Pentacheles*, where some have the branchial lash (mastigobranchia) large, others small, and in some it is wanting altogether, and this variation occurs in specimens which differ little in external appearance, and which were procured in some instances from the same locality.

One of the most conspicuous variations of structure, and most convenient for examination, is to be found in the branchial appendages. In some genera these organs are developed as a series of leaf-like plates, in others they exist as feather-like plumes of slender cylinders, and again they are found to divide into a series of tree-like branches,

while in others they are absent from the pereion, or attached to the pleon also; consequently nearly every carcinologist who has attempted to construct a natural classification has made use of characters founded upon the branchial apparatus.

The broad division in the general structure of the branchial organs has long been recognised, and its full value appreciated. Dana[1] says, "The branchial system is one from which we should particularly expect important distinctions and valuable characteristics of the highest significance, and such distinctions exist. They are at the basis of some of the primary subdivisions, as exhibited in the systems of Milne-Edwards, and to a large extent also in the system of De Haan."

It is, however, very remarkable that, with this full conviction and desire, Dana has not utilised his observations beyond those of previous writers, who divided the Decapod Crustacea into two groups,—one having the branchiæ protected by a carapace, the other having them uncovered and pendent. Dana's terms of "Eubranchiata" and "Anomobranchiata" are synonymous with "branchies cachées" and "branchiogastres," the first and second orders of the Malacostraca of Latreille's earlier classification, and the Decapoda and Stomapoda of his later.

The system of De Haan is based on the arrangement of the branchiæ to such an extent as to divide the Macrura into two portions, separating those in which the organs consist of a series of long cylindrical filaments from others in which the structure is foliaceous, consisting of a series of leaf-like plates.

But De Haan appears to have appreciated the numerical value of the branchial character rather than the position of the plumes in relation to the general structure of the animal.

The great object of a natural systematic arrangement is to determine the internal structure by external evidence, without which it appears to me no classification can be perfect, especially in the future, when extinct forms must be studied in their relation to existing species, and this can only be done in the Crustacea through the preservation and knowledge of the harder or external parts.

The classification of Latreille separates the Macrurous Crustacea, in which the branchiæ are attached to the anterior limbs, and protected by the carapace, from those which have the branchiæ attached to the posterior limbs, or unprotected; that is, those in which the branchiæ belong to the pereion from those in which they are attached to the pleon, or absent.

This general arrangement has been adopted by Milne-Edwards and Dana with scarcely a variation in the general outline, and the subdivisions of their classifications also closely correspond. Thus the "Astacini" of Latreille agree closely with the "Astaciens" of Milne-Edwards, and the two tribes, Thalassinidea and Astacidea of Dana, correspond respectively with two divisions of the "Astacina" of De Haan.

[1] United States Explor. Expedition, vol. i. p. 61.

In the following table (pp. 4, 5) I have brought together, in one general scheme, an outline of the several classifications that have been adopted by the more distinguished carcinologists, so far as they relate to the Macrurous Crustacea.

It is interesting to observe how closely these different systems correspond as to their general conclusions, the chief points of distinction being with regard to those genera which, while they resemble one group in external form, approach some other group in some important structural character.

The arrangement of Latreille agrees closely with that of De Haan, even to the introduction of the phyllobranchiate families of the Paguridæ and Porcellanidæ among the anomurous forms.

The classification of Milne-Edwards differs in separating the Eryonidæ, Scyllaridæ, and Palinuridæ from the Astacidea, where all other authors, excepting Heller, place them, and in grouping them along with the Galatheidæ.

Dana differs from the others in the exclusion of the Galatheidæ and allied families from the Macrura altogether, and in forming a sub-tribe to receive *Penæus* and its allied genera, among which he includes *Stenopus*.

The more recent system proposed by Professor Huxley is almost identical with that of Latreille, as given in Cuvier's Règne Animal, 2nd ed., vol. iv., 1829, and quoted by Milne-Edwards in his Hist. des Crust., t. i. p. 217, differing only in the removal of the family of the Penæidæ from among the Salicoques, where all preceding authors, excepting Dana, have placed it, and transferring the same to range with the Trichobranchiata, a section that corresponds with that of the "Homards" of Latreille, and is synonymous with the three divisions—Astaciens, Thalassiniens, and Cuirassés of Milne-Edwards—and with the *Astacina* of De Haan. It, moreover, corresponds with the Astacidea, Thalassinidea, and Penæidea of Dana, and with the Loricata, Astacidea, and Thalassinidæ of Heller, whose classification is identical with that of Milne-Edwards, excepting in the terms selected for the names of the separate groups.

It would thus appear that the various systems of classification have failed to receive acceptance by each successive naturalist, from the circumstance that the several tribes or groups have received their distinguishing title from the most prominent or distinctive animal in its respective group or tribe, a circumstance that must render a nomenclature very liable to be changed with any variation of individual thought, dependent upon the opportunity of study, as well as with the increase of knowledge through extension of research.

The nomenclature recently suggested by Professor Huxley, being based upon the structural character of the branchiæ, appears not to be open to this defect.

He has proposed that the Macrura be divided into three groups,—the Trichobranchiata, the Phyllobranchiata, and the Abranchiata.

Trichobranchiata are those that have the branchial plumes made up of long

TABLE SHOWING THE VARIOUS SYSTEMS OF CLASSIFICATION ALREADY PROPOSED.

LATREILLE, . . . 1831.

- **Order I. DECAPODA.**
  - Family II. MACROURES.
    - Section 1.
    - Section 2.
      - (9) Carides. *Palæmon.*
    - Section 3.
      - (10) Coleopoda.[1] *Cryptopus.*
- **Order II. STOMAPODA.**
  - Family I. CARIDIOIDES. — *Thysanopoda.*
  - Family II. UNIPELTATA. — *Squilla.*
  - Family III. BIPELTATA. — *Phyllosoma.*

Division I.

- Subdivision 1.
  - (1) Notopterygia. *Albunea.*
  - (2) Hippides. *Hippa.*
  - (3) Pagurii. *Pagurus.*
- Subdivision 2.
  - (4) Scyllarides. *Scyllarus.*
  - (5) Palinurini. *Palinurus.*
- Subdivision 3.
  - (6) Galathinæ. *Galathea.*
- Subdivision 4.
  - (7) Thalassinides. *Thalassina.*

Division II.

- (8) Astacini. *Astacus.*

MILNE-EDWARDS, 1837.

- **DECAPODES.**
  - MACROURES.
    - CUIRASSÉS.
      - Galathéides.
      - Eryons.
      - Scyllariens.
      - Langoustiens.
    - FOUISSEURS.
      - Cryptobranchides.
      - Gastrobranchides.
    - ASTACIENS.
      - *Astacus.*
      - *Homarus.*
      - *Nephrops.*
    - SALICOQUES.
      - Crangoniens.
      - Alphéens.
      - Palémoniens.
      - Pénéens.
        - *Stenopus.* *Oplophorus.*
        - *Penæus.* *Pasiphæa.*
        - *Sicyonia.* *Sergestes.*
        - *Ephyra.* *Acetes.*
- **STOMAPODES.**
  - CARIDIOIDES.
    - Mysiens.
    - Leuciférians.
  - BICUIRASSÉS.
    - *Phyllosoma.*
    - *Amphion.*
  - UNICUIRASSÉS.
    - Erichthiens.
    - Squilliens.

DE HAAN, . . . 1850.

- ANOMALA.
  - Galathedea.
  - Porcellanidea.
  - Hippidea.
  - Paguroidea.
  - Lithodeacea.
- ASTACINA.
  - Scyllaroidea.
  - Palinuridea.
  - Eryonidea.
  - Astacoidea.
    - *Homarus.* *Thalassina.*
    - *Nephrops.* *Gebia.*
    - *Astacus.* *Callianassa.*
    - *Axius.* *Callianidea.*
    - *Laomedea.*
- CARIDES.
  - Palæmonidea.
  - Alpheidea.
  - Crangonidea.
  - Atyadea.
  - Penæidea.
    - *Penæus.* *Sicyonia.*
    - *Stenopus.* *Sergestes.*
    - *Spongicola.* *Pasiphæa.*
- STOMAPODA.
  - Unipeltata.
    - *Squillidea.*
    - *Erichthidea.*
  - Caridina.
    - *Mysidea.*
    - *Lewiferidea.*
    - *Amphionidea.*
  - Bipeltata.
    - *Phyllosoma.*

DANA, 1852.

EUBRANCHIATA.

THALASSINIDEA.	ASTACIDEA.	CARIDEA.	PENÆIDEA.
Gebidæ.	Scyllaridæ.	Crangonidæ.	Penæidæ.
Callianassidæ.	Palinuridæ.	Atyidæ.	Sergestidæ.
Thalassinidæ.	Eryonidæ.	Palæmonidæ.	Eucopidæ.
	Astacidæ.	Passiphæidæ.	

ANOMOBRANCHIATA.

Squillidæ.	MYSIDEA.
	Mysidæ.
	Euphausidæ.
	Leuciferidæ.

HELLER, 1863.

LORICATA.	THALASSINIDÆ.	ASTACIDÆ.	CARIDÆ.		ANOMOBRANCHIATA.
Galathea.	*Gebia.*	*Polycheles.*	*Crangon.*	*Typton.*	*Myssis.*
Munida.	*Callianassa.*	*Astacus.*	*Nika.*	*Antonomea.*	*Squilla.*
Scyllarus.	*Calliaxis.*	*Homarus.*	*Lysmata.*	*Palæmon.*	*Gonodactylus.*
Pseudibacus.		*Nephrops.*	*Gnathophylla.*	*Alphæus.*
Palinurus.			*Caridina.*	*Athanus.*
			Troglocaris.	*Hippolyte.*
			Ephyra.	*Verbius.*
			Pasiphæa.	*Sicyonia.*
			Pandalus.	*Penæus.*
			Pontonia.	*Stenopus*
			Anchistia.	

CLAUS, 1880.

Family VIII. HIPPIDÆ.	Family VII. PAGURIDÆ. Subfamilies. (1) Paguriuæ, (2) Birgidæ.	Family VI. THALASSINIDÆ.	Family V. GALATHEIDÆ.	Family IV. PALINURIDÆ. Subfamilies. (1) Scyllarinæ. (2) Palinurinæ.	Family III. ASTACIDÆ.	Family II. CARIDIDÆ. Subfamilies. (1) Penæinæ. (2) Palæmoninæ. (3) Alphæinæ. (4) Atyinæ. (5) Pasiphæinæ. (6) Crangoninæ. (7) Gnathophyllinæ.	Family I. SERGESTIDÆ.

HUXLEY, 1883.

TRICHOBRANCHIATA.

ANOMOMORPHA.	CARCINOMORPHA.	CARIDOMORPHA.
Thalassinidæ.	Palinuridæ.	Penæidæ.
Axiidæ.	Parastacidæ.	Stenopidæ.
	Potomobiidæ.	Euphausidæ.
	Homaridæ.	

PHYLLOBRANCHIATA.

ANOMOMORPHA.	CARIDOMORPHA.	CARCINOMORPHA.

ABRANCHIATA.

MYSIDÆ.

[1] "The tribe of the Schizopoda having been found (by the recent observations of M. Milne-Edwards) to be reduced to the single genus *Cryptopus*, and this offering certain characters which distinguish it from the *Salicoques*, I have retained it in its isolation, but changed the name of the tribe and given to it one more appropriate to the particular character of the genus, that of *Colepodes*, because the carapace serves as a sheath for the feet."—Latreille, Cours d'Entomologie, p. 385.

cylindrical filaments; *Phyllobranchiata* are those that have the plumes formed by a series of foliaceous plates; *Abranchiata* are those that have no such branchial plumes attached to the pereion.

As most of the genera that belong to this last division possess branchiæ attached to some part or other, the term appears to be misleading.

The Galatheidæ and allied families that author separates from the rest of the Trichobranchiata, and ranges under the head *Anomomorpha*, which, except for the exclusion of the Paguridæ and the Porcellanidæ, neither of which are trichobranchiate, coincides with the *Anomaux* of Latreille and the *Anomala* of De Haan.

The Penæidæ, through the Stenopidæ, are supposed to lead from the trichobranchiate form to the phyllobranchiate.

Observation on the structure of the branchiæ of the Penæidæ, however evolved, demonstrates the character of a plume that belongs to a group in which the development is essentially distinct. Although I think we shall be able to show that the branchiæ of the Penæidea as well as those of the phyllobranchiate division have their origin in the trichobranchiate form, I shall, for the convenience of a general classification, range in a separate division those Crustacea in which the branches of the various plumes divide and subdivide in an aborescent manner; the more so as those Macrura that possess this kind of structure form a well-marked natural group.

In this Report I therefore follow Dana in placing the Penæidea in a separate division, as they do not belong either to the Phyllobranchiata or to the Trichobranchiata. I therefore classify them under the head of *Dendrobranchiata*, which corresponds closely with the Penæidea of Dana; while the Squillidæ, Mysidæ, &c., that is, the Schizopoda originally, and later the Stomapoda of Latreille, Edwards, and De Haan, will be arranged under the head of *Anomobranchiata*, which term was first used by Dana, and afterwards by Heller. It has, therefore, priority of date, and is less liable to misconception than the term Abranchiata.

The following classification of the Macrura—for much of the arrangement of which I am indebted to the experience of all previous carcinologists, and which is based to a large extent on the development and external evidence of the internal structure—will, I think, be found to approximate the conditions required for a natural classification :—

Suborder **MACRURA.**

Trichobranchiata.	Dendrobranchiata.	Phyllobranchiata.	Anomobranchiata.

Division TRICHOBRANCHIATA.

The Trichobranchiata may conveniently be divided into two well-defined groups, one containing those genera in which the most typical characteristics of the order are persistent, the other containing those that depart from them more or less distinctly, both as to the character and arrangement of the branchiæ as well as in possessing some variation in the plan of the external structure and development. The former of these may readily be designated by the term NORMALIA, being those of the most typical condition, and the latter by that of ABERRANTIA, or those that depart more or less distinctly from the perfect character.

Group ABERRANTIA.

Group.	Family.		Brephalos.
ABERRANTIA.	GALATHÆIDÆ.	*Galathea.* *Munida.* *Æglea.* *Grimothea.*	Zoea.
	PYLOCHELIDÆ.	*Cheiroplatea.* *Pomatocheles.* *Pylocheles.*	Zoea?
	THALASSINIDÆ.	*Thalassina.*	
	CALLIANASSIDÆ.	*Callianassa.* *Cheramus.* *Scallasis.* *Tripæa.* *Calliadina.* *Gebia.*	
	AXIIDÆ.	*Axius.* *Paraxius.* *Eiconaxius.*	Megalopa.
	THAUMASTOCHELIDÆ.	*Thaumastocheles.* *Calliaxus.* *Calocaris.*	

Cephalon having the carapace short and compressed, with little or no rostrum. Pereion having the posterior somite articulated with the preceding. Pleon having the somites long, and not overlapping each other; coxal plates but feebly developed, with the post-inferior angles generally rounded. Ophthalmopoda small; antennæ having the peduncles long. Perciopoda more or less chelate, first pair longest, posterior pair having a tendency to separate from the preceding, and directed backwards. Pleopoda long, biramose, variable. Rhipidura strong, powerful, variable.

This group may be separated into two divisions,—first, in which the animal is dorso-ventrally compressed; second, in which the animal is laterally compressed.

The first division corresponds only with the tribe Galatheides of Milne-Edwards's Division, Macrura Cuirassés, and part of the Loricata of Heller.

The second division corresponds with the tribe Macrura Fouissures or Thalassiens of Milne-Edwards, Thalassinidea of Dana, and Thalassinidæ of Heller, and contains several families, which, while they have a character that is common to all, yet possess features that are extremely at variance with one another in very closely affiliated forms.

Their structural relations assimilate them to the Anomura, and where they depart from that resemblance, they do so by approaching the condition of immature forms. The genus *Pomatocheles*, like the Paguridæ, inhabits molluscous shells, and possesses all the external characters of an Anomurous Crustacean, and *Pylocheles* was taken dwelling in the hollow of a mass of indurated sand. These facts induce the belief that *Cheiroplatea* may also reside in some dwelling-place of its own selection. In this latter genus we see a close resemblance in the cephalic appendages to those of the Anomurous form in the genus *Cenobita*, whereas the rest of the animal approximates to the character of the immature stage of *Pagurus* described by Milne-Edwards under the name of *Glaucothoë*, with the exception that, while *Glaucothoë* exhibits evidence of a tendency to bilateral variation, *Cheiroplatea*, *Pylocheles*, and *Pomatocheles* are perfectly symmetrical. The same remarks may also be applied with perhaps less force to the genus *Thalassina*, which approximates to *Pagurus*, as the previous genera resemble *Cenobita*. The branchiæ are variable in this group, but with a tendency, more or less complete, to the trichobranchiate condition; in some genera, as in *Thalassina*, they are both foliaceous and filamentous; in some filamentous and cylindrical, as in *Cheiroplatea;* in others filamentous and compressed, or flattened, as in *Eiconaxius*, with a tendency, where the pressure is less complete, to return to the cylindrical condition.

Callianassa retains all the external features of an Anomurous Crustacean, but is modified from the younger form which approaches the Macrurous type; this is most constantly exhibited in the tendency of the posterior two pairs of periopoda to undergo a variation from the original simplicity and normal use.

All carcinologists following Milne-Edwards classify the genus *Callianidea* not only in a separate family but also in a distinct group, forming the tribe of the Gastriobranchides of Milne-Edwards, the legion Thalassinidea anomobranchiata of Dana. It has been established on the strength of Milne-Edwards's description of *Callianidea*, and Guérin's description of *Isæa* (*Callianisea*, Milne-Edwards; *Callisea*, Dana), but which (from an examination of specimens lent to me by Dr. Carte of the Dublin Museum) I am inclined to place in the same family as *Callianassa*. The two genera resemble each other very closely in all points except the formation of the pleopoda. Those of the second pair in *Callianassa* are biramose; the inner branch slender, the outer of extreme

tenuity. Those of the three following pairs are also biramose, but the inner branch is short and broad; the outer is long and wide, being bent over the inner; the margins are smooth, inflected, and fringed with a delicate ciliary growth. In *Callianidea* the second pleopoda resemble those of the three succeeding pairs. They are biramose and foliaceous; the margins, instead of being fringed with small hairs or cilia, have these modified into soft and flexible articulated membranous filaments. These, it is assumed, are true branchial appendages; but whether they fulfil the function of aeration of the tissues or not, it appears to me that in classification they can only be regarded as finely modified hairs, and, consequently, are only of generic import. The genus *Isæa* of Guérin, which Milne-Edwards changed into *Callianisea*, because Guérin's name had previously been in use, and which has again been changed by Dana into *Callisea*, to prevent the confusion likely to ensue from the resemblance between *Callianassa* and *Callianisea*, appears to me to have been founded upon a damaged specimen of *Callianidea*. The character assigned as a distinctive feature was the presence of only one branch attached to each pleopod; but the imperfect condition of the specimen examined induced Milne-Edwards to suggest that this arrangement was the result of an accident. The only distinction between *Callianidea* and *Callianisea* of Milne-Edwards (the latter being *Isæa* of Guérin), rests upon the author's statement that the pleopoda are furnished with a great number of little branches grouped together. Or, to use his own words: "garnie d'un grand nombre de ramuscules en form de grappe," which Milne-Edwards supposes to mean that the ramuscules were inserted together directly on the base of the pleopoda.

An examination of the structure of the pleopoda in *Callianidea*, which is incorrectly figured by Milne-Edwards,[1] shows that the ramuscules are massed together, forming a bundle attached to the margin of the base of the inner branch of the pleopoda, not to the peduncle, as suggested by Milne-Edwards.

The branchiæ of *Callianassa* and *Callianidea* resemble each other, and appear to form a transition between the trichobranchiate and phyllobranchiate types. They consist of long and narrow filaments, which are closely packed and laterally compressed, they are arranged in two longitudinal rows, and differ from those of *Cheiroplatea* in being more numerous, and are consequently compressed instead of being cylindrical.

The genus *Axius*, while still retaining some of the features, more especially in external aspect, of the Thalassinidæ, exhibits a character that approximates its species to those that belong to the family of Astacidæ.

For example, the podobranchiæ are present, being attached to several of the pereiopoda, and, according to my observation, in *Paraxius* and *Eiconaxius* the mastigobranchiæ are present to an equal degree, and form a consistent feature in leading us gradually to the family Thaumastochelidæ, in which all the branchiæ and their mastigobranchial

[1] Hist. Nat. des Crust., pl. xxv. *bis*, fig. 14.

accompaniments are developed as effectively as in the most highly-organised apparatus of any genus in the families of the NORMALIA.

It appears, therefore, taking into consideration the external features in connection with the branchial characters, that the following is the natural classification :—

Group ABERRANTIA.

Pereion short, posterior somite loosely articulated with the preceding; pleon long, somites increasing in size posteriorly, not overlapping each other dorsally; first pair of pereipoda more or less imperfectly chelate; posterior pair short, more or less abnormal; branchiæ variable in number and form.

Division I.

Family GALATHEIDÆ.

Pereion broad and dorsally depressed; carapace anteriorly produced into a rostrum; first pair of antennæ with flagella short, second pair without a scaphocerite; second pair of gnathopoda pediform; first pair of pereiopoda chelate, subequal; second, third, and fourth simple, robust; posterior pair enfeebled; pleon broad and depressed; somites short and slightly overlapping each other; rhipidura equilateral and foliaceous. In development the brephalus takes the form of a zœa. Genera *Galathea, Munida, Grimothea.*

This family will be reported on by Prof. J. R. Henderson, M.B., F.L.S., in another volume of this series.

Division II.

Family PYLOCHELIDÆ.

First pair of antennæ with flagella short; second pair with scaphocerite; first pair of pereiopoda chelate, symmetrical; rhipidura rigid; telson transversely divided; branchiæ filamentous, in two rows, cylindrical; mastigobranchiæ and podobranchiæ wanting. Genera *Cheiroplatea, Pomatocheles, Pylocheles.*

Family THALASSINIDÆ.

First pair of pereiopoda subchelate, unequal; branchiæ filamentous and foliaceous; rhipidura rigid; mastigobranchiæ and podobranchiæ rudimentary. Genus *Thalassina.*

Family CALLIANASSIDÆ.

First pair of antennæ with flagella long, second without a scaphocerite; first pair of pereiopoda asymmetrical, unequal; rhipidura foliaceous; branchiæ filamentous, compressed.

(A) Podobranchiæ and mastigobranchiæ wanting; second pair of pleopoda unlike the third and following pairs. Genera *Callianassa, Cheramus, Scallasis, Trypæa.*

(B) Podobranchiæ wanting; mastigobranchiæ present; second pair of pleopoda like the following pairs. Genus *Callianidea.*

(C) First pair of pereiopoda subchelate; rhipidura foliaceous; branchiæ like *Callianassa;* second pair of pleopoda like the following pairs. Genus *Gebia.*

Family AXIIDÆ.

First pair of pereiopoda chelate, subsymmetrical, unequal; branchiæ filamentous, cylindrical, and compressed; podobranchiæ and mastigobranchiæ present. Genera *Axius, Paraxius, Eiconaxius.*

Family THAUMASTOCHELIDÆ.

First pair of antennæ with flagella long, second with scaphocerite; first pair of pereiopoda unequal, chelate, large; second symmetrical, chelate, small; rhipidura foliaceous; branchiæ filamentous cylindrical; podobranchiæ and mastigobranchiæ present. Genera *Thaumastocheles*, *Callocaris*.

Family PYLOCHELIDÆ.

The carapace has no rostrum, and its lateral walls are compressed and very deep. The eyes stand on peduncles of moderate length. The first pair of antennæ terminates in two short flagella, and the second supports a small scaphocerite. The mandibles carry a synaphipod. The first pair of pereiopoda is subequal, chelate. Second and third pairs long and slender, each terminating in a long styliform dactylos. Fourth and fifth pairs are short, and terminate in a small, and more or less rudimentary dactylos. Rhipidura with the branches rigid and tapering; outer larger than the inner. Telson rigid anteriorly, and flexile posteriorly.

The respiratory apparatus is trichobranchiate. The filaments are long, slender, and cylindrical. The podobranchial plumes and mastigobranchial plates are wanting throughout all the appendages of the pereion, that is, from the first pair of gnathopoda to the posterior pair of pereiopoda.

This family is established to receive the genera *Pomatocheles*, Miers, *Pylocheles*, A. Milne-Edwards, and *Cheiroplatea*.

The name is derived from that given to a genus by A. Milne-Edwards, and includes all those paguriform Anomura that are trichobranchiate.

Cheiroplatea,[1] n. gen.

Carapace having deep lateral membranous walls, produced anteriorly in advance of the dorsal frontal margin.

Ophthalmopoda broadest at the base, and tapering gradually to the apex.

First pair of antennæ having the peduncular joints long, each capable of being folded upon the preceding, and terminating in two slender flagella that are longer than the third joint of the peduncle.

Second pair of antennæ having a strong and small scaphocerite attached to the peduncle.

Mandibles carrying a triarticulate synaphipod.

Second pair of gnathopoda imperfectly chelate, and carrying a basecphysis.

First pair of pereiopoda with the two limbs correspondingly equal, being large and well developed, having the anterior or upper surface of the carpos and propodos

[1] χείρ, hand; πλατύς, flat; this name was chosen and the plate printed before I became aware that the somewhat similar name *Chiroplatys* had been previously used by Kirby for a genus of Diptera.

flattened and bent at an angle with the other joints, by which peculiar feature in the animal the name of the genus is suggested.

The second and third pairs of pereiopoda terminate in a long and strong dactylos.

The fourth and fifth pairs are shorter than the two previous, and terminate in a small and rudimentary dactylos.

The pleopoda are slender, except those of the sixth pair, which are robust and strong, form part of the rhipidura, and terminate in points partially covered with a pavement of spiculiform spines.

The telson is divided into an anterior and a posterior portion by an articulation, the alimentary canal terminating at the posterior extremity of the anterior division.

This genus corresponds somewhat nearly with *Polycheles* of A. Milne-Edwards[1] and *Pomatocheles* of Miers,[2] from both of which it differs in the form of the ocular peduncle, the length of the first pair of antennæ, and the general aspect of the animal.

Cheiroplatea cenobita, n. sp. (Pl. I. fig. 1).

Carapace without a rostral tooth, having the lateral walls deep and membranous. Pleon half as long again as the carapace. Telson quadrate, articulated with a terminal plate.

First pair of antennæ nearly as long as the carapace, each terminating in two small flagella. Second pair scarcely longer than the first, having a scaphocerite with serrate margin; the second joint of the peduncle armed with a serrate tooth.

First pair of pereiopoda chelate; anterior and upper surface of the carpos and propodos flattened; carpos fringed with a crenate transverse crest; propodos inverted downwards and backwards. Second and third pairs of pereipoda long and slender. Fourth and fifth short, and terminating in a rudimentary dactylos; propodos of the fifth pair having the surface furnished with a pavement of obtuse spicules. Lateral branches of the rhipidura pointed and covered with a pavement of blunt spicules.

Length (female) 25 mm. (1 inch).

Habitat.—Station 194, September 29, 1874; lat. 4° 34′ S., long. 129° 57′ 30″ E.; between the Arrou Islands and Banda; depth, 200 fathoms; bottom, volcanic mud.

Viewed dorsally, the carapace is nearly circular, having no projecting rostrum, but a slight prominence between the eyes. The latero-frontal angles are produced anteriorly a little beyond the line of the rostral point. The gastric is well defined from the hepatic and frontal regions; the branchial is also separated from the hepatic, but not distinctly from the cardiac region. The lateral walls of the carapace, which are visible only when

[1] Blake Expedition Crustacea, *Bull. Mus. Comp. Zoöl.*, vol. viii. p. 38.

[2] Edw. J. Miers, On a Collection of Crustacea made by Capt. H. C. St. John, R.N., in the Corean and Japanese Seas, part i. Podophthalmia, *Proc. Zool. Soc. Lond.*, January 14, p. 18, 1879.

the animal is viewed laterally, are membranous from a little below the line which defines the branchial from the hepatic region, and extend posteriorly beyond the line of the posterior margin of the dorsal surface of the carapace.

The pleon is longer than the carapace by about one half, but as the posterior portion is generally folded beneath the body it looks shorter. The first somite is short and triangular, having the broadest part situated posteriorly. It is nearly hidden beneath the carapace, and does not support any coxal plates. The five anterior somites are subequal in length, and rather broader than long. They are quadrate in their dorsal aspect, and have a distinct line of demarcation separating the body of the somite from the lateral or coxal plates, which are rounded at the anterior and posterior angles: they have a longitudinal line of depression near the middle of each, and the margins are fringed with delicate cilia. The sixth somite is also quadrate, and rather longer than the fifth, it supports the coxal plates at the posterior angles, where they support a freely-articulating joint that carries a pair of unequal branches. The seventh somite or telson is divided into an anterior and a posterior portion by a free-moving joint near the middle. The anterior portion is undoubtedly homologous with the somite, and the posterior with its appendages, since the alimentary canal debouches at the posterior margin of the anterior division.

The ophthalmopoda consist each of a sharp-pointed ophthalmus situated at the extremity of a large broad-based peduncle that gradually narrows to the apex; the peduncle is movable, but not to any very large extent, and is situated in a slight excavation in the frontal margin of the carapace; from the inferior margin of the eye the metope falls perpendicularly, and on the outer side of it, immediately below and outside the eye, is the first pair of antennæ, which consists of three peduncular joints; the first or coxal is very long, reaching as far again as the distal extremity of the eye; in its length it curves downwards, and has the upper surface longitudinally excavated to receive the second joint when folded back: on each side of the excavation is a strong tooth—one on the outer side near the base, the other on the inner side at the distal extremity; the second joint is about the same length as the first, but somewhat more slender; it is nearly cylindrical in shape, and when folded back falls into the longitudinal hollow of the first joint, the two spines acting apparently as guides to its position; the third joint is shorter than the second, and is also cylindrical; and when the antenna is folded up it is directed forwards. At the extremity of this third joint are situated two slender flagella; the primary branch is the longer and more robust, being about twice the length of the third joint of the peduncle; the secondary branch is about half the length of the primary.

The second pair of antennæ is implanted immediately outside the first. The first joint supports a phymacerite that is curved inwards and downwards, impinging at its extremity, which is serrate, against a small tubercle situated on the outer edge of the

metope; the second joint is produced at the distal external angle into a strong spine-like process, which is deeply serrate on the outer margin; within this is implanted a movable appendage, which resembles very much the spine-like process already described; like it, it is serrate, but not so deeply, on the outer margin; it articulates with the second joint, and is homologous with the scaphocerite; the fourth joint is short but longer than the two preceding; the fifth is very long and cylindrical, supporting at its extremity a slender flagellum less conspicuously multiarticulated than the primary flagellum of the first pair.

The mandibles consist of a pair of strong, externally convex blades, the anterior and upper portions of which articulate with the lower and outer angles of the metope, above which, on the anterior margin, articulates a three-jointed synaphipod, the first joint of which is short and subcylindrical, the second, long and triangular, of which one angle is attached to the extremity of the first joint; another extends upwards and forwards so as to fill the upper portion of the aperture of the mouth, and the third angle supports the third or last joint of the appendage, which is long and tapering, and falls within the mandible; it appears to be hairless, and lies folded between the epistoma and the mandible.

The first pair of siagnopoda appears[1] to consist each of two flat branches—one slender, rigid, and curved, terminating with a fringe of cilia, the other short and membranous, with five or six cilia attached.

The second pair of siagnopoda is foliaceous and five-branched, four of which are fringed with closely-packed cilia: the fifth is long, slender, flagellum-like, free from cilia, and outside it is a large squamiform plate, copiously fringed with long delicate hairs.

The third pair of siagnopoda consists of two single-branched, two-jointed appendages. The basal joint is strong, and produced into a lobe internally; the second or distal joint tapers gradually (the outer margin convex, the inner concave) to the apex. The inner margin is thickly fringed with strong cilia, which increase in length towards the apex.

The two pairs of gnathopoda are subpediform, and carry each a long secondary ramus (basecphysis) which corresponds in form more with the Macrurous than the Anomurous type of Crustacea. The first pair is small, subpediform, and consists of seven joints; the second or basisal joint supports a long basecphysis; the next three succeeding joints are subequal and tolerably robust; the sixth, or propodos, is short and tapers to the apex from its base; and the seventh, or dactylos, is unguiculate. The three terminal joints are copiously fringed with long and strong cilia. The basecphysis is comparatively very long, extending considerably beyond that of the primary branch of the gnathopod, which generally lies curved downwards, while the basecphysis extends outwards and upwards.

The second pair of gnathopoda is much longer than the first, and likewise

[1] I say "appears," because the appendage was broken, the two portions being asunder; and there is but a solitary specimen in the collection.

consists of seven joints, and is formed on the same general type. The basisal joint is short and irregular, and carries a long branch consisting of three joints, which is generally at right angles with the gnathopod, and lies parallel with that of the first pair, and stands upright by the side of the mouth. The first joint of this branch is long and cylindrical; the second is more slender, and lies generally at right angles with the first; and the third consists of a multiarticulate flagellum fringed with long slender hairs. The third joint (ischium) is long and angular (the internal margin has on the interior angle a strong projecting process, and has one strong spine a little beyond the centre); the fourth joint is about half the length of the third, is angular, and is armed with three teeth or spines on the inner margin; the fifth joint is scarcely longer than the fourth, and increases in diameter towards the distal extremity, where the outer angle supports a small brush of long hairs: the propodos, or sixth joint, increases in diameter towards the extremity, where the inner angle is produced into a polliciform lobe, and is tipped with a brush of long and strong hairs: the outer distal angle also has a small brush of cilia; the dactylos, or seventh joint, scarcely reaches beyond the extremity of the corresponding process of the propodos, against which it impinges and forms a cheliform extremity—a character, in my experience, that is unique among the higher Crustacea. Such a chela exists in some of the Edriophthalmous Crustacea, but, as far as I am aware, the form has not been previously observed in the Podophthalmia.

The next pair of appendages is the first of the pereiopoda. It is a large and powerful pair of organs, the peculiarity of which lies in the formation of the carpos and propodos: the limb, as far as the carpos, is laterally compressed and directed forwards, when it is suddenly compressed transversely, and abruptly bent downwards at an acute angle: the anterior or upper surface of the reflexed portion of the carpos, as well as that of the propodos and dactylos, is compressed flat. The outer margin is curved and the inner strait, so that when the right and left limb are brought together they, being of equal size, form a nearly oval plane, the upper or carpal portion of which is fringed with a row of equidistant comb-like dentations. The dactylos is sharply pointed, and impinges closely against the pollex, which it overlaps at the extremity.

The second pair of pereiopoda is of the normal form, and consists of seven joints, of which the carpos, propodos, and dactylos are subequal in length.

The third pair resembles the second both in size and form, and in the female carries the vulvæ in the form of a large circular opening on the posterior surface of the coxa. The coxa of these two pairs of legs approach each other more closely than those of the two following pairs, which are smaller and wider apart.

The fourth pair terminates in a small sharp dactylos which is considerably and suddenly smaller than the propodos. The fifth or last pair of pereiopoda has the distal extremity of the propodos enlarged and covered with a thick pavement of small tubercular spiculiform points.

There are five pairs of pleopoda: four consist of small and slender biramose appendages, which support the ova in the female; the fifth is strong, stiff, and sharp-pointed, and helps to form the rhipidura.

Observations.—The object of the peculiar formation of the first pair of pereiopoda is very difficult to discover, except it be that of forming an operculum, so as to protect the entrance, should the animal reside in a shell or enclosure of any kind; the arms are incapable of being directed in an extended position, and therefore cannot be advanced to grasp any object beyond the extremity of the antennæ. The two succeeding pairs are long and slender, but the last two—the penultimate and ultimate pairs of pereiopoda—possess the Anomurous character of being very much shorter, and have the dactylos in the penultimate almost rudimentary in size. In the ultimate pair the propodos is paved over with a number of closely-packed spiculiform points of nearly equal size, which increase somewhat toward the extremity—among which it is difficult to determine the dactylos. These features in the pereiopoda are strongly suggestive of an approximation to the Anomurous form; but an examination of the branchial appendages reveals a character that approximates to the Macrura, more especially to those belonging to the family of the Thalassinidæ. In *Birgus*, *Pagurus*, *Cenobita*, &c., to which *Cheiroplatea* approximates most nearly in form, the respiratory organs are phyllobranchiate in character; in this genus they are trichobranchiate, the filaments being cylindrical and arranged in two longitudinal rows, bearing a resemblance to those of the Astacidea, from which they differ in the absence of the podobranchial and mastigobranchial series of the appendages, which form important features in the respiratory organs of the latter. As a whole the arrangement of the several branchial plumes corresponds more nearly with those species that are generally grouped with the family Thalassinidæ than with those that belong to the Astacidæ.

The mastigobranchia is absent from all the pereiopoda and from both the gnathopoda, and so are the podobranchiæ. Two arthrobranchial plumes are present on each of the pereiopoda and one on each of the gnathopoda; and the pleurobranchiæ exist in connection with the three posterior somites of the pereion, as shown in the following table:—

Pleurobranchiæ,	...	...	...	...	1	1	1			
Arthrobranchiæ,	1	1	2	2	2	2	...			
Podobranchiæ,	...	...	...	...	...	...	...			
Mastigobranchiæ,	...	...	...	...	...	...	...			
	h	i	k	l	m	n	o			

The plumes are generally small, and increase in size posteriorly. Of the three pleurobranchiæ, the last is the only plume attached to the posterior somite; whereas the penultimate and ultimate somites, besides a pleurobranchia, carry an anterior and posterior anthrobranchial plume. But the somites which support the anterior two pairs

of pereiopoda have no pleurobranchiæ, but carry an anterior and posterior arthrobranchial plume attached to the pleurocoxal articulation.

The gnathopoda, both first and second, have only a single arthrobranchial plume; but whether they support a small mastigobranchia I have not been able to determine, from a desire not to dismember too largely a unique specimen of an interesting character.

The pleopoda are small and delicate appendages, each consisting of one long and one very short filamentous branch, fringed with long cilia, to which the ova are attached by thread-like fibres. The ova are very large and not very numerous, numbering about twenty in our specimen. Unfortunately these were in too immature a condition to enable me to determine the form and character of the future brephalos, or the stage at which the young are hatched.

The external plates of the rhipidura (or sixth pair of pleopoda) are Anomurous in character, but Macrurous in so far as that the appendages on the two sides are symmetrical.

The telson is peculiar, and instead of terminating as a single-jointed plate, there is a well-defined separation into an anterior and a posterior part by a joint-like line of division; the former has its coxa-marginal lobes, and the termination of the alimentary canal corresponds with its posterior margin, whereas the posterior division articulates with the former, and exists only as a movable plate.

The entire animal suggests its being in an intermediate stage, and bears a considerable generic resemblance to *Glaucothoë* of Milne-Edwards. But this latter has been shown (Brit. Assoc. Report, 1869) to be an intermediate form between the brephalos and the adult *Pagurus*. *Cheiroplatea*, like *Glaucothoë*, not only carries five pairs of pleopoda, but has the posterior pair equilaterally developed. It has, moreover, the dorsal surface of the pleon protected by Crustaceous plates, all of which *Glaucothoë* loses when, with increasing age, it fulfils the habits of its kind—takes to itself the shell of a dead Mollusc, and so passes from a Macrurous to an Anomurous condition.

Cheiroplatea appears in its adult condition to represent an intermediate link between *Cenobita* and the trichobranchiate Macrura. But the remarkable feature appears to be that its nearest allies in the Anomurous group belong to the phyllobranchiate condition of Crustacea. It has an appearance strongly suggestive of its being allied to a *Pagurus* that had failed to obtain a molluscous shell for itself, and had consequently retained some of the Macrurous characters of its youthful condition.

Its general appearance is not that of a swimming animal; we may consequently feel assured that it was brought up by the dredge from the bottom, which was about half a mile from the surface of the ocean, south of New Guinea. In this case the temperature of the bottom is not recorded. It was taken associated with *Eiconaxius acutifrons* and a species of *Ophlophorus*.

The arrangement and form of the chelæ induce me to believe that the little creature inhabited some abode where the flattened claws afforded an efficient operculum. This

idea is supported by a closely analogous form taken in the West Indies during the "Blake" expedition under the superintendence of Professor Agassiz, and named by Professor Alphonse Milne-Edwards *Pylocheles agassizii*.

Family THALASSINIDÆ.

Carapace produced anteriorly to a point in advance of the frontal margin; dorsally flattened. Eyes small; ophthalmopoda cylindrical. First pair of antennæ having the flagella long; second pair without a scaphocerite.

First pair of pereiopoda unequal, imperfectly chelate, the pollex being shorter than the dactylos.

The four following pairs of pereiopoda not chelate, terminating in a long dactylos; outer rami of the rhipidura without diæresis, slender, rigid, pointed. Telson without diæresis, rigid, obtuse, pointed. Branchiæ complex, trichobranchiate at the base, and phyllobranchiate on the exterior of each plume.

This family corresponds with Dana's, and contains, so far as research has yet proved, only a single genus.

Thalassina, Latreille.

Geographical Distribution.—A very fine specimen of one species of this genus, measuring 225 mm. in length, was procured at Kandavu, one of the Fiji Islands. It has been preserved in a bottle with fresh water prawns, and, not being labelled as coming from any station, was, I presume, procured from the natives, and not dredged. Milne-Edwards records it from the coast of Chili, while Desmarest states that it comes from the Indian seas. Heller, in the voyage of the Russian frigate "Novara," obtained it from the Nicobar Isles. Although the localities recorded are not numerous, they are sufficient to show the very wide area over which the animal is distributed, and if, as I am strongly induced to believe from the description given by Heller in the work quoted, *Thalassina maxima* is only a smooth variety of *Thalassina scorpionoides*, and the little *Thalassina gracilis* of Dana only the young of this same species, then we shall find that the geographical distribution extends from Singapore to Sydney, and across the Pacific and Indian Oceans. Even if these two specimens be distinct, their separation is not great, for the young, when only an inch and a half long, as is that of *Thalassina gracilis*, if not identical, must closely approximate to it in form; while *Thalassina maxima* appears to be only a less pronounced specimen of the typical species. A genus that is represented by a single species, the distribution of which is so very wide, would, we should presume, have structural conditions decidedly favourable to natural acclimatisation.

Thalassina scorpionoides, Latreille (Pls. III., IV.).

Thalassina scorpionoides, Latr., Gen. Ins. et Crust., tom. i.
Cancer anomalus, Herbst., tom iii. tab. 62.
Thalassina scorpionides, Leach, Zool. Misc., vol. iii. p. 28, tab. 130; Desmarest, Consider. des Crustacés, p. 203, pl. xxxv. figs. 1, 2 *a*, *b*, *c*; Milne-Edwards, Hist. des Crust., tom ii. p. 316; Atlas du Règne anim. de Cuvier, Crustacés, pl. xlviii. fig. 1; Heller, Russ. frigate "Novara," p. 93.

Habitat.—Kandavu, Fiji Islands. One specimen.

Length, 225 mm. (9 inches).

The eyes are small, movable, and subconical in shape. Deposited in an imperfect orbit, formed by the obliquely directed inferior surface of the rostrum, on the inner side; by two teeth, one on the upper and outer angle being the anterior extremity of a short, smooth ridge or crest; the second, a smaller tooth, immediately beneath it; and on the lower side by an excavation in the upper surface of the inner antennæ, where a fringe of posteriorly directed hairs, coterminous with others that are anteriorly directed from the side of the rostrum, as well as from the upper external circuit of the orbit, forms a blepharis that surrounds and protects the eye.

The first pair of antennæ has the inner surface of the first joint compressed and flattened against that of the opposite side, the other surfaces slightly converging, and directed upwards; the second joint is much smaller and also directed upwards, the upper surface being slightly concave, and, with that of the first joint, forms a hollowed floor on which the eye rests; the upper surface of the first or coxal joint is perforated by an elongated triangular foramen or slit, the entrance to the auditory chamber, which is protected by a dense mass of ciliated hairs, also continuous within the auditory passage.

The auditory apparatus consists of a large calcareo-membranous chamber, attached to the upper wall of the antenna. Around the orifice that opens into it, within the chamber, there is a curved row of closely-planted delicately-ciliated hairs, each of which is attached to the base by a flexible membranous articulation, from which it proceeds flattened and tolerably broad for more than half its length, when it narrows rapidly and becomes ciliated, the cilia being short and fine; the hairs extend nearly if not quite across the auditory chamber, the floor of which is covered with small points, while the cavity contains much angular calcareous sand. This I found mostly gathered into a compact mass, but most probably when the animal was in a living condition it was not so, being then kept in a state of motion by the aid of the long slender ciliated hairs that have just been described. The auditory chamber occupies about two-thirds of the cavity of the first joint of the antenna.

The second pair of antennæ is in the same horizontal line with the first, immediately outside, being separated by a very narrow septum or calcified ridge. The five joints of which the peduncle is formed are separately defined, and this enables us to demonstrate

the parts which exist in those genera where the calcification has more or less obliterated the means of identifying the several joints. There is no scaphocerite. The phymacerite is produced to a large lobe, but the closing membrane is rather small, and is situated in the first or coxal joint. The third joint supports a fasciculus of finely ciliated hairs, and the flagellum is formed of short articuli, each of which supports a few stiff hairs of the same length as the articulus.

The siagon or mandible is a tolerably strong, powerful organ, the psalisiform margin of which is denticulated, and produced in a continuous curve until it unites with the molar prominence, which is only a more strongly pronounced denticulation. The apophysis is long, and the synaphipod is two-jointed; both joints are short, robust, subequal, hairy, the second articulating with the first at a right angle and terminating in an obtuse point, and resting generally in the cavity between the incisive and molar denticulations.

The first pair of siagnopoda has three branches. The outer is cylindrical, curved at the extremity, and clean and smooth except for a few hairs on the anterior margin, which closely press upon the mandible. The central lobe is foliaceous and expanded at the extremity, bat-shaped, fringed with short spinous hairs on the inner margin, and with long ones on the extremity and distal portion of the posterior margin. The inner lobe is also foliaceous, very wide, short, and fringed at the inner margin with numerous closely packed hairs.

The second pair of siagnopoda consists of five foliaceous plates of great tenuity, and a long mastigobranchial appendage. Generally it resembles that of *Astacus* except in the form of the mastigobranchia, which in this genus is very narrow and produced to a considerable length, and fringed at the extremity with very long hairs, furnished with a series of minute, short, stiff cilia, spirally arranged ; for some distance from the base these small cilia point posteriorly, or towards the base of the hair, and for the rest, which is more than half the length of the hair, they point anteriorly, or towards the apex or distal extremity, which terminates in a slightly curved blunt point—the cilia gradually dying out as they advance. The foliaceous plates are broad, short, thickly ciliated at the margins, and the mastigobranchia extends to a considerable distance within, so that the hairs on the extremity reach to quite half the length of the chamber, and are the only appendages that are capable of action on the branchiæ.

The third pair of siagnopoda is derived from the type seen in *Astacus*. It consists of an equally long and broad basal joint, fringed on the inner margin with a fur of cilia, and at the extremity with three foliaceous branches, of which the inner is broad and furred all over, while the other two are slender and fringed with rather long hairs towards the extremity only.

The first pair of gnathopoda appears to be only six-jointed, and a comparison of the several joints homotypically with those of the second pair suggests that the meros and ischium are united together to form one long straight joint, the carpos

and propodos are short and form a rigid curve, and terminate in a short flat spatuliform dactylos that is distally fringed with stiff spines. The coxa supports an imperfect or rudimentary forked mastigobranchia, tipped with long hairs, and a podobranchial plume made up of trichobranchial filaments and phyllobranchial plates longitudinally implanted on the stem. The basis carries an ecphysis that is as long as the gnathopod.

The second pair of gnathopoda has seven joints, the meros and ischium being distinct and continuous; both, but more especially the ischium, are longitudinally grooved or excavated, forming a hollow in which lies closely impacted, when at rest, the first long joint of the basecphysis; the carpos is long and curved, the propodos straight, and the dactylos long and straight, fringed on both the upper and under margins with long hairs, as also on the under or inner side of the propodos, ischium, and meros. The basecphysis is about two-thirds the length of the gnathopod, and is fringed with long hairs. The coxa supports a short, slightly curved, rigid mastigobranchia, fringed on the lower margin with short hairs and tipped with long ones at the extremity; from the base of the mastigobranchia arises a well-developed podobranchial plume; the lower and basal portion of the posterior or inferior side consists of a series of trichobranchiate filaments, and on the anterior portion, near the distal extremity of the same side, are several phyllobranchial plates. On the coxa near the podobranchial articulation is a single bunch or fasciculus of long hairs.

The first pair of pereiopoda consists of six articulated joints, the basis and ischium being fused together, leaving a distinct line of union defining the unused articulation between the two joints. The right is much larger than the left, and the coxa supports a short, curved, stiff, almost rudimentary, mastigobranchial process, thickly fringed with a fur of short hairs along the lower margin, and tipped with long hairs that are serrate along the sides; from the base of the mastigobranchia arises a well-developed podobranchial plume, consisting of trichobranchial filaments attached to the stem from the base to the extremity on the under side, and three phyllobranchiate plates at the distal extremity on the upper side, not far from the articulation of which, on the coxa, stand two well-formed fasciculi of long hairs, fringed with minute, sharp, short cilia, similar to those pointed out by Professor Huxley as existing in the genus *Astacus*. These two fasciculi are distinct from each other, well defined, and the hairs are as long as the podobranchial plume. The left differs from the right in size but resembles it in form, and is imperfectly chelate. The dactylos is long, arched, diagonally compressed, and reaches considerably beyond the extremity of the short, sharp pollex of the propodos: it is fringed with hairs upon the outer margin and with short blunt truncated denticulations on the inner, and only at the base impinges against the anterior serrated margin of the pollex: the propodos is quadrate, nearly as broad as long, compressed and slightly rounded both on the inner and outer surfaces, flattened on the upper, and fringed with strong hairs on the upper and lower margin; the carpos is short and triangular in

form, articulating with the meros at its extremity, and bending at a right angle with it. The meros is long and broad, flat on the inner and rounded on the outer side; lower margin straight, and armed with fine teeth and numerous long hairs; upper margin convex, and fringed with coarse strong teeth; articulates with the ischium by an oblique joint with lateral movement. The ischium is triangular, long and denticulated on the lower side, except near the distal extremity, where it is fringed with long hairs; the outer margin is represented only by a point at which the articulation of this joint meets the meros on one side and the coxa on the other, the basis being short and fused with the ischium. The coxa is stout and robust, and supports a short, stiff mastigobranchia, similar to, but a little longer than, that on the first pair of pereiopoda, and a well-developed podobranchial plume, at the base of which stand two fasciculi of branchial hairs.

The second, third, and fourth pairs of pereiopoda resemble each other. The dactylos is curved in a reverse direction from the common plan; it is straight for some distance, and the apex terminates in an outward and forward curve. The posterior margin is fringed with hairs; the anterior surface has two lines of elevation or crests, the inner or the one nearest the body is thickly fringed with hair, the outer is armed with a row of strong teeth, which terminates in the apex or unguis. This joint is not capable of being bent at more than right angles with the propodos: the propodos is subcylindrical, longer than broad, the upper margin is wide and armed with tufts of hair; the carpos is long, nearly as long again as the propodos, gradually narrowing from the distal to the nearer or meral articulation; meros long, laterally compressed, the anterior and posterior margins parallel and serrato-denticulated; ischium and basis fused together, about half the length of the meros, denticulated on the posterior, and mostly on the anterior margin; coxa large, quadrate. In the female those of the third pair approach each other, and are perforate near the interno-posterior angle for the vulva, near which the coxa articulates with the ventral surface of the pereion, whereas in the fourth pair the articulation is near the centre of the posterior margin of the coxa, instead of at the inner angle; the two limbs are distant from each other, being attached to wider ventral plates. In both these pairs of pereiopoda the coxa supports a short mastigobranchial appendage, of which the posterior is the longer. Both are fringed with short hairs along the lower margin, and tipped with long ones at the extremity.

The fifth pair of pereiopoda articulates with a somite that is not fused with the rest of the pereion. It much resembles that of the preceding pair, but is more cylindrical generally, especially as regards the meros. The ischium is shorter, the propodos longer, and the dactylos not excentrically curved. The coxa is large, deeper than broad, and approximates very nearly to that of the opposite side.

The first pair of pleopoda in the female is a three-jointed styliform appendage, short and closely impacted in the ventral groove of the posterior somite of the pereion.

The following four pairs of pleopoda are long, slender biramose, on a long basisal

joint. The outer branch flat multiarticulate, the inner two-jointed—one cylindrical, the other multiarticulate and flattened; both fringed with a few long hairs.

The sixth or posterior pair of pleopoda is biramose on a short basisal joint. The branches are uniformly stiff and narrow, being of the same length as the telson, slender, tapering, slightly curved and fringed with hairs, and form the lateral plates of the rhipidura.

The branchial chamber is very large, as may be observed from the anterior position of the cervical furrow, and the dorsally narrow and posteriorly still narrower gastric, genital, and cardiac regions. The inner surface of the carapace is covered with a membrane plicated in a series of fine ridges or folds, radiating from a position near which the muscles of the mandibles are attached to the carapace. This membrane is smooth and clean, and terminates on the interior surface at the posterior margin of the carapace, where a series of thickly-set hairs form a fringe capable of assisting to afford a protection against the admission of extraneous matter. The floor, or pleural surface of the same great chamber, is smooth and highly polished, and is not covered or protected by any tissue. The surface is generally even, but a sudden depression corresponds with cavities that hold the muscles of the gnathopoda. The enlargement or elevation of the portion posterior to these appendages corresponds with the functional requirements of the several pereiopoda.

The branchial formula of this species is—

Pleurobranchiæ,	...	...	...	...	...	...	...	...	...	...
Arthrobranchiæ,	2	2	2	2	2	2	...	...	...	...
Podobranchiæ,	1	1	1	1	...	...	...	...	...	...
Mastigobranchiæ,	r	r	r	r	r	...	...	...	...	...
	h	i	k	l	m	n	o			

There are no pleurobranchial plumes attached to either of the somites. There are two arthrobranchial plumes attached to the articulations of all the appendages of the pereion except the last pair of pereiopoda. There are only four podobranchiæ, and these are appendages of mastigobranchial rods of a reduced and imperfect character. Six similarly formed mastigobranchiæ are attached to the six anterior appendages of the pereion, the last, or fifth, pair of pereiopoda being without any branchial apparatus whatever. A similarly formed mastigobranchia, being more important in character, extending in length to a considerable distance within the branchial chamber, is attached to the second pair of siagnopoda; whereas the third or next succeeding pair posteriorly has none.

Observations.—The branchiæ of this animal are of a peculiar character, and form an interesting feature in their relation to the entire order to which they belong.

The second pair of siagnopoda, as I have just stated, supports a long mastigobranchial appendage, that carries on its margin, more especially at the extremity, numerous extremely long and tolerably stiff hairs of peculiar formation. They are generally straight and rigid, but some are curved at the extremity. As a whole, these hairs gradually

decrease from the base to the apex; but for about one-half the distance there appears to be a stronger and more important fibrous arrangement than there is within the remainder; and, coinciding with this variation in internal structure, there is an alteration in the direction of the small stiff cilia that run spirally round the surface externally—those towards the base being directed backwards, those towards the extremity being directed forwards and spirally reversed. This appendage, from its extent and position in the branchial chamber, evidently plays an important function in the branchial system, situated as it is at the anterior opening, and has probably the control over the circulation of the water within the branchial chamber.

The third pair of siagnopoda has not even the rudiment of any mastigobranchial plate. In this it differs from most of the higher Crustacea. Its position is so forced in and compressed that there appears to be scarcely room for the requirements of such an addition, and is absent accordingly.

The mastigobranchia of the first pair of gnathopoda is short, bifid, almost rudimentary, furnished with long rigid hairs at the extremity, and carrying at its base a short podobranchial plume. This plume consists of long trichobranchiate filaments, until they approach the extremity, when they assume a phyllobranchiate character, the petals of which are arranged in a position longitudinal to the axis of the plume. Above, on the membranous articulation, are two arthrobranchiæ. The anterior is trichobranchiate, with the exception of two other phyllobranchiate petals that terminate the plume. This plume is also short, being scarcely as long as the podobranchia. The posterior arthrobranchia is very long and entirely phyllobranchiate, with the exception of a few filaments of an intermediate character at the base. These latter, as they approximate the phyllobranchiate petals, increase their diameter at the base, and become flattened, and so gradually pass from one form into the other. The petals are arranged longitudinally, with the longer axis of the plume on each side of the median line—the longer on the anterior and the shorter on the posterior margin, the longest being the terminal petals, each of which is traversed by a set of channels, without definite walls, that assume an arborescent appearance.

The mastigobranchia attached to the second pair of gnathopoda is short, although a little longer than that of the first pair. It is slightly curved, rigid, furred with numerous short hairs along the lower margin, and subapically tipped with long, straight hairs (which have been accidentally omitted by the lithographer). It supports at its base a long and well-developed podobranchial plume, consisting of a series of phyllobranchiate petals traversing the whole length of the under margin of the longitudinal axis of the plume; while a series of trichobranchiate filaments are attached to the base. On the coxa, near the branchial articulation, are two fasciculi, or bundles of straight hairs. There are two arthrobranchiæ attached to the membranous articulation; the anterior is rather shorter than the posterior. Both have a mass of trichobranchiate filaments attached to the base of a long plume of phyllobranchiate petals of considerable number and size. In the

anterior arthrobranchia the central or supporting axis, particularly towards the base, appears to be rigid and multiarticulate, each articulus supporting one or more obtusely pointed processes, the rudiments probably of undeveloped trichobranchiate filaments.

The mastigobranchia, with its attendant podobranchial plume attached to the coxa of the first pair of pereiopoda, resembles that of the second pair of gnathopoda both in size and form. At its base are two fasciculi of long straight hairs, which under the microscope are seen to be fringed with fine cilia. Those that spring from the apex of the mastigobranchia are, under the fifth of an inch microscopic power, seen to have their edges serrated rather than ciliated. The anterior arthrobranchia is short, supporting on the under side a row of moderately long trichobranchial filaments on a rigid stem; the upper has a few of these at the base, while the distal extremity supports three broad phyllobranchiate petals. The posterior arthrobranchia is long and phyllobranchiate, the petals being arranged on the posterior margin of the stalk longitudinally from the base to the apex. A bundle of pendent trichobranchiate filaments is attached to a rigid and curved support that appears to be only connected with, and not part of, the longitudinal axis of the long phyllobranchiate plume.

The mastigobranchia and podobranchia belonging to the second pair of pereiopoda bear a close resemblance to the appendages attached to the first pair. The anterior and posterior arthrobranchia are also similar, consisting of a long plume of phyllobranchiate petals, one or two of which at the base are double, beneath which is a bundle of trichobranchiate filaments.

The mastigobranchia of the third pair of pereiopoda supports no podobranchial plume, and the anterior and posterior arthrobranchiæ are long and well developed, resembling those of the second pair, being phyllobranchiate, and having the largest petal at the base, near the root of which, on the under side, a bundle of trichobranchiate filaments is attached.

The mastigobranchia of the fourth pair of pereiopoda, like that of the preceding pair, supports no branchial plume, and the arthrobranchiæ also resemble the preceding, but are much longer, and in the posterior the trichobranchial filaments extend to the foot of the apical petal, decreasing in length gradually from the base, where they are abundant, to the extremity, where they thin out to a single row.

There is neither mastigobranchial lash nor branchial plume attached to the fifth pair of pereiopoda and the posterior somite of the pereion. This last somite is not fused with the rest of the pereion, but connected by membranous attachments, that admit of a limited amount of movement on the part of the somite, and one of a more extended degree in every direction in the case of the posterior pair of pereiopoda.

The branchiæ are of two distinct kinds, one consisting of finger-like processes or cylindrical filaments, the other of broad thin foliaceous plates. The former are trichobranchiæ, the latter are phyllobranchiæ.

The trichobranchiæ exist as bundles, or fasciculi, and are situated at the base of nearly all the branchial plumes, whereas the phyllobranchial plates traverse the stem from the base to the apex, not compressing each other laterally, but implanted with their broad axis in the longitudinal direction of the stem. In some instances the plates slightly overlap one another, but generally they are fixed end to end.

The trichobranchiate filaments are at the base, just within the margin of the carapace, and exist as a peculiar branchial arrangement corresponding with the lower margin of the branchial chamber, increasing in size and number at the anterior and posterior extremities.

The phyllobranchiate plumes lie farther within the branchial chamber, and compared with the area, appear to occupy but a small portion of the space.

Thus we see that the trichobranchiate bundles are arranged mostly where the water plays most actively and freely, that is, along the margin and at the afferent and efferent passages of the branchial chamber, while the phyllobranchiate plumes lie where the water within the chamber is less likely to be disturbed.

I think there can be little doubt that the phyllobranchial plates and the trichobranchial filaments are derived from one and the same origin, as we see at the base that the one gradually passes into the other. In *Cheramus* this also appears to be the case, though the close compression of the one against the other is probably an inducing cause; but probably there are also other conditions brought into play. The foliaceous petals are not implanted one against the other, but are exposed freely in the chamber. Examination of these plates shows that within the several petals the structure is traversed by canals that assume an arborescent appearance, through which the fluid circulates and is brought by the tenuity of the apparatus into closer contact with the aerating agents than it otherwise would be.

In a respiratory chamber, such as in the genus now before us, the water flows in by the posterior extremity, for which purpose the carapace can be raised or depressed at will within certain limits; and as we may assume that in a large chamber such as the present, the water flows along the lower margin, passing out at the anterior end only, it is probable that the largest amount of current will correspond with that portion of the chamber where the trichobranchiate filaments are best developed and most abundant, whereas the phyllobranchial plates are present in the centre and deeper recesses of the chamber, where the circulation will be more quiescent, and the power of oxygenation less efficient.

We do not know much of the habits of this animal, but many of the group are burrowers in the deposits beneath the seas in which they live, hence it is more than probable, from the matted condition in which I found the fur that covers many parts of the animal, that it inhabits hollow passages in the mud, and that the circulation of the

water through the branchial chamber cannot be very vigorous, and consequently in that portion of the chamber that is most distant from the direct current, the circulation will be very inactive. In the central portion of the chamber the branchiæ, instead of consisting of cylindrical rods, are developed into thin foliaceous plates of considerable dimensions, through the tenuity of the structure of which the blood is brought over a large surface into contact with the aerating medium within the chamber. The circulatory channels seen within the plates demonstrate the organs to be of a complex structure, and capable of performing a function of a less simple kind—namely, of extracting the oxygen from water that has been stored for a long period where it has not been affected by the atmosphere.

I am aware that this is mere speculative reasoning from the appearance and condition of the organs, and that we must know more about the habits and mode of existence of the animal before we can determine with certainty what separate duties or functions these two varieties of branchial organs effect.

That neither of them can be the depauperised form of the other I feel assured, inasmuch as the variation in the several parts of the animal exhibits no depreciation of structure.

The various organs may be abnormal in form, but they are evidently well adapted for their purpose; the mandibles are strong, and the synaphipod, which is required for sweeping food within reach of the incisive margin of the mandible, is a very powerful and efficient appendage. The stomach is a large and capacious organ, complicated in its structure, and adapted for the comminution of substances into a form that adapts them for assimilation.

The points of interest which this Crustacean possesses have induced me to give a detailed description of the several parts of its structure. Although the animal is not new, it has never been fully described; and the only figures, so far as I am aware, are a small one in Desmarest's Consid. des Crustacés, another in Leach's Miscellany, and in Cuvier's Atlas to the Règne Animale.

The animal is interesting, and not only supplies a link connecting the Macrurous with the Anomurous Crustacea, but also shows that the trichobranchiate structure is intimately associated with the phyllobranchiate form, that the one is only a modification of the other in adaptation to varied conditions.

Family Callianassidæ.

The several genera of this family are conveniently determined by the gradually increasing size of the somites of the pleon, together with the great breadth of the foliaceous plates of the rhipidura, and by the asymmetrical character of the first pair of pereiopoda, which generally have a tendency for the right to be larger, deeper, and less perfectly

chelate than the left, which approaches the more normal form. The carpos of the right side is generally formed as if it were a continuation of the propodos; this is particularly so in *Callianassa*, *Callianidea*, and *Trypæa*, and we presume from their general resemblance to the typical genus that it is the same also in *Cheramus* and *Scallasis*, of which genera, unfortunately, our specimens have lost the first pair of pereiopoda.

The genus *Gebia* differs only in this respect, but in nothing else can I detect any anatomical point of separation of more than generic value, and, according to Professor Huxley's observations, the branchiæ are of the same specific character as is found in the type of this family.

Both the podobranchia and mastigobranchia are wanting in *Callianassa*, but the mastigobranchia is present in *Callianidea* in the form of slender plates fringed with hairs, and at its base a small bud-like process represents the podobranchia.

Thus it appears that in the form of the carapace, in the subchelate character of the first pair of pereiopoda and the less Anomurous condition of the posterior pair, *Gebia* approximates to *Thalassina*, whereas in the form of the rhipidura, and in the condition of the branchiæ, it approaches nearer to *Callianassa;* it resembles *Callianidea* in having second pair of pleopoda constructed in the same form as the third and following, although fringed with articulate ciliated hairs as in *Cheramus*. It therefore appears correct to divide this family into three divisions.

Division A.

The carapace is ovate, the rostrum is reduced to a small point, and the posterior pair of pereiopoda is minutely chelate; the podobranchiæ, mastigobranchiæ, and pleurobranchiæ are entirely absent; the second pair of pleopoda is slender and filamentous, and the three following are broad, foliaceous, and fringed with ciliated hairs.

Callianassa, Leach.

The structure of the branchiæ of *Callianassa* is so intermediate in character that it may be claimed by anatomists as belonging to either the Phyllobranchiata or to the Trichobranchiata, as the plumes consist of two rows of long slender filaments so closely impacted together that they are flattened into plates; but we see in *Cheramus* that when the pressure is relieved, the filaments assume a cylindrical form, as in the typical Trichobranchiata, with which the external features of the animal strongly associate it.

The following table shows the arrangement of the branchiæ as observed in *Callianassa longimana*:—

	h	i	k	l	m	n	o
Pleurobranchiæ,	...	...	...	...	...	...	...
Arthrobranchiæ,	...	2	2	2	2	2	...
Podobranchiæ,	...	...	...	...	...	...	...
Mastigobranchiæ,	1	...	...	...	...	...	...

By this it will be seen that all the branchial plumes are absent, except those of the arthrobranchiæ, and the mastigobranchiæ are wanting on every appendage except the first pair of gnathopoda, where one is seen in the form of a rudimentary bulb.

Geographical Distribution.—Eighteen species of this genus have been described, and, from the various localities recorded, they appear to be sparsely scattered all over the globe. Some are stated to belong to the western coast of North America, and two to the western coast of South America; two to the eastern coast of North America, including the West Indies; one is from Europe, two from the western coast of Africa, including Cape Verde; the rest from the Pacific and islands of the Indian Ocean.

This scattered distribution suggests that the small number of specimens found is due to the burrowing habits of the animal rather than to paucity of specimens.

Geologically, *Callianassa* has only been found in the more recent series of formations. The largest specimen, *Callianassa maxima*, A. Milne-Edwards, stated to have been found at a great distance from the sea, in alluvial soil, on cutting a canal in Siam. Another, *Callianassa crassa*, A. Milne-Edwards, was found in the Miocene sands of St. Paul, near Dax. Others have been recorded from the Calcaire grossier de Parmes, and the Environs of Gisors; the sands of Beauchamp, and the Chalk formation of Bohemia, according to Anton Fritsch, have yielded six species.

Callianassa occidentalis, n. sp. (Pl. II. fig. 2*k*).

The propodos is smooth, longer than broad, and broader than the carpos, which is also longer than the palm, or that portion of the propodos that does not include the pollex. Meros as long as the carpos, the lower margin compressed to a thin convex plate posteriorly serrate. Ischium long, flexed, imperfect.

Habitat.—Station 23, March 15, 1873; lat. 18° 24′ N., long. 63° 28′ W.; off Sombrero Island, West Indies; depth, 450 fathoms; bottom, Pteropod ooze. Associated with *Cheramus occidentalis*.

A solitary specimen of the larger of the first pair of pereiopoda is all that was taken of this animal. This limb appears to differ from that of any known species, more particularly from that of *Callianassa major* (Say), the only one that has been taken in the same neighbourhood, and which is described as having the meros armed with a very strong tooth. It is not impossible that it may belong to the species *Cheramus occidentalis*, but it is too large to have belonged to the specimen with which it was taken.

Cheramus, n. gen.

This genus resembles *Callianassa* generally, but differs in having the second pair of gnathopoda pediform; in the form of the second pair of pleopoda; in the third and following pairs being ciliated, and in having strong spines, more or less curved, on the posterior margin of the rhipidura.

Observations.—In *Callianassa*, according to Milne-Edwards's figure and description,[1] the second pair of gnathopoda is broad and operculiform, whereas Leach[2] describes and figures the same as being pediform. Bell[3] says that the same part is very broad, but does not give a figure of the structure, although the specimen that he is describing belongs to *Callianassa subterranea*, the same species from which Leach and Edwards drew their descriptions.

De Haan[4] describes the part as being dilated, but figures it as being pediform; whereas Dana, in his description of the genus, has overlooked it altogether.

I have thought it desirable, therefore, to separate those in which the second pair of gnathopoda are pediform from those in which they are operculiform, although feeling it not improbable that further investigation may show that the two forms may be dependent on either difference of age or sexual distinction, although such a condition is not usual.

Cheramus orientalis, n. sp. (Pl. I. fig. 2).

Carapace smooth, with a short pointed rostrum. Branchial regions distinctly defined from the gastric and cardiac. Second pair of gnathopoda pediform. Posterior pair of pleopoda having the outer plate much larger than the inner. Telson long, quadrate.

Habitat.—Station 188, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; Arafura Sea; depth, 28 fathoms; bottom, green mud.

Length, 12·5 mm. (half an inch).

There was but a single specimen taken, and this, unfortunately, in a very damaged condition; all the limbs were broken off except the first pair of antennæ, the oral appendages, one of the posterior pair of pereiopoda, and some of the pleopoda.

It resembles *Callianassa* in its general appearance; but the second pair of gnathopoda does not form an efficient operculum.

The ophthalmopoda are horizontally compressed, and formed like a disk with a pointed extremity, the eye being situated in the middle of the outer surface.

[1] "Les pates machoires externes sont operculiformes," Hist. Nat. des Crust., vol. ii. p. 308, pl. xxv. *bis*, fig. 2.

[2] "Palpi pediformes articulo secundo compresso longiore," Malac. Pod. Brit., pl. xxxii.

[3] "External pedipalps, with the second and third joints very broad, constituting when in contact a broad oval disk and terminating in a small seta formed of the last three joints," Hist. Brit. Stalk-Eyed Crustacea, p. 217.

[4] "Max illarum palpi nulli, art. 2^{i} et 3^{ii} dilatati," Siebold's Fauna Japonica, Crustacea, p. 162 tab. v.

The first pair of antennæ has the two flagella nearly equal in length, but the primary is the larger, and is furnished with numerous membranous cilia near the extremity. The secondary flagellum is slender and almost destitute of cilia; both flagella have the articuli strongly defined.

The second pair of antennæ has only the peduncle preserved, and this is nearly as long as the first.

The second pair of gnathopoda is pediform. The coxa and basis are short. The ischium is long, and has the infero-internal margin strongly serrated. The meros, carpos, and propodos are subequal; the dactylos is wanting. Each of the joints is copiously supplied with long hairs, more particularly on the under margin.

The posterior pair of pereiopoda is small, and terminates in a chelate hand immersed in a brush of hairs.

The first pair of pleopoda is slender, feeble, and single-branched.

The second pair is long, slender, and double-branched, the inner ramus being two-jointed; a few long hairs fringe the termination of each joint.

The next three pairs of pleopoda consist of large foliaceous plates. The margins of the inner plate are thickly fringed with strong multiarticulate hairs, furnished with short cilia on both sides; the inner margin carries a short, stout stylamblys, the apex of which is crowned with small obtuse-pointed hooks (cincinnuli). The outer plate has the outer margin fringed with long multiarticulate hairs, ciliated on one side only, while the inner margin carries a row of distantly placed, solitary, simple straight hairs.

The posterior pair of pleopoda (the rami of the rhipidura) has the outer branch much larger than the inner. The peduncle is short, and the foliaceous plates somewhat pear-shaped in form. The posterior margin of the outer plate is thickly fringed with both long and short spines, and hairs, plain and ciliated, some of which on the inner angle increase in size and length until they become long and stout spines, with a slight curve or hook at the extremity. These are repeated for a short distance on the outer corresponding angle of the inner plate, where the spines are curved in the opposite direction, and mingled with hairs only that are fringed with long cilia. On the posterior lateral margin of the telson there are, mixed with the ciliated hairs, two sharp, short spines on each side.

Observations.—Our specimen has the branchiæ approximating closely to those of *Callianassa* both in arrangement and in character. They consist of four pairs of arthrobranchiæ and one podobranchia according to the following formula:—

	h	i	k	l	m	n	o
Pleurobranchiæ, ...	...	...	...	...	...	...	...
Arthrobranchiæ, ...	...	...	2	2	2	2	...
Podobranchiæ, ...	...	1	...	...	...	...	...
Mastigobranchiæ, ...	...	...	...	...	...	...	...

The plumes attached to the third pair of pereiopoda are affixed somewhat within the basal extremity, and have the branchial processes somewhat longer at the base, beyond which they rapidly and gradually decrease to the distal extremity, where they lose their lateral compression and appear as cylindrical papillæ. The plumes attached to the second pair of gnathopoda have the processes very long and foliaceous at the base; and after three or four such processes rapidly decrease in size, and become cylindrical, the extremity of the stem of the plume terminating obtusely.

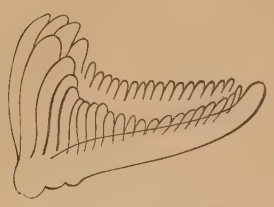

FIG. 1.—Branchial plume of *Cheramus orientalis.*

The second pair of pleopoda is biramose, one branch extending from the terminal extremity of the basisal joint, the other, a long and slender one, from the side. The third and following are formed as in *Callianassa,* but support a small stylamblys tipped with minute cincinnuli, and both plates are fringed with hairs that are ciliated and multiarticulate.

There is no doubt that this and the following specimens might have been considered as one species had they been found in the same locality; as it is they may probably be a form common to species before they have attained their mature condition.

This species was taken in comparatively shallow water at the entrance of Torres Strait, off the south coast of New Guinea.

Cheramus occidentalis, n. sp. (Pl. II. fig. 1).

Carapace smooth, with a sharp rostrum, reaching nearly to the extremity of the ophthalmopoda. Branchial region defined from the gastric. Telson long, quadrate; posterior margin rather narrower than the anterior, fringed with long ciliated hairs, and having in the median line a strong sharp tooth, and two short sharp spines on the posterior half of the lateral margins.

Habitat.—Station 23, March 15, 1873; lat. 18° 24′ N., long. 63° 28′ W.; off Sombrero Island, West Indies; depth, 450 fathoms; bottom, Pteropod ooze.

Length, 18 mm. (three-fourths of an inch).

The carapace is laterally deep and generally smooth. The rostrum, laterally compressed, projects anteriorly to a sharp point until it reaches nearly as far as the extremity of the ophthalmopoda, which are pointed and rather longer than broad, laterally compressed, and have the eye at the centre of the outer surface. The flagella of the anterior antennæ are nearly of the same size and length. The second joint of the second pair of antennæ is extremely long, and the last is short; the rest of the appendage is wanting. The pereiopoda are all broken off at the basisal joint, the two anterior pairs of pleopoda are slender, the three succeeding are small and fringed with cilia. The

posterior pair of pleopoda has the outer branch much larger than the inner, and both have the inner margin fringed with ciliated hairs, and the extremity furnished with hairs and spines.

The mastigobranchial plates and podobranchial plumes are entirely wanting, and so also are the pleurobranchiæ, and in this respect the character of the organs is consonant with those of *Callianassa*, inasmuch as the only plumes that are present are the arthrobranchial, which, however, appear to vary as to number, as shown in the following formula :—

	h	i	k	l	m	n	o
Pleurobranchiæ, ...	...	...	...	...	...	...	...
Arthrobranchiæ, ...	...	...	2	2	2	1	...
Podobranchiæ, ...	...	...	...	...	...	...	...
Mastigobranchiæ, ...	...	...	...	...	...	...	...

A variation exists not only in the number, but also in the form of the structure, more especially in that of the anterior plumes; the tendency being to form large and broad foliaceous plates at the base of the stem, changing in some cases rather suddenly into slender cylindrical processes, that gradually shorten toward the apex of the plume.

Unfortunately there was but a single specimen taken of this interesting little species, and that in a very damaged condition.

Comparing it with the species that we have just described as being taken at the entrance of Torres Straits, in only 28 fathoms of water,—a locality that is almost the antipodes of the other; the one in lat. 19° N. and long. 63° W., while the other was taken in long. 10° S. and 142° E.,—the similarity of the two is very remarkable. The only distinctions by which I could positively determine the one from the other are in the form of the rostrum, branchiæ, and telson, and perhaps of the lateral caudal pleopoda. In *Cheramus orientalis* the telson has the posterior margin fringed with long ciliated hairs, and in the median line there is a very rudimentary point at the bottom of a slight depression. In *Cheramus occidentalis* this depression exists, while in the median line there is a well-defined straight tooth.

The lateral caudal pleopoda have their armature, although strongly spinous, yet scarcely as hooked in form as in *Cheramus orientalis*.

On the inner branch of the third pair of pleopoda is a small stylamblys, rather more pointed than in *Cheramus orientalis*, and fringed with small cincinnuli or hooklets.

With this species was taken an anterior right or large cheliped (Pl. II. fig. 2*k*). It appears to be rather too large to belong to the individual I have described, but it may belong to another specimen of the species (see p. 29).

The branchial plumes of the two species of this genus, which come from such distant localities, are very instructive in their character. In *Cheramus orientalis*, the arthrobranchia attached to the second pair of gnathopoda is very short, and carries a

series of lobes, arranged in two rows running from the base to the apex of the plume: those at the base are long, broad, flat, and foliaceous; those near the apex are slender, rounded, and digitiform.

In the second pair of pereiopoda the arthrobranchial plume approximates more nearly to the form which exists in *Callianassa*, that is, of two longitudinal rows of long and slender plates compressed closely against one another; but as these plates approach the extremity of the plume, they lose the flattened or compressed condition, and have a more cylindrical appearance.

Fig. 2.—Arthrobranchia of *Cheramus occidentalis*.

In *Cheramus occidentalis* the arthrobranchia attached to the first pair of pereiopoda consists of a double row of long flat plates which gradually become narrow and slender, rounded and digitiform, lessening in length as they approach the apex of the plume—as shown in the accompanying woodcut.

In one instance on the posterior arthrobranchia a process had commenced as a broad and flattened plate, and then became compressed into a narrow cylindrical continuation, showing, I think, very clearly that the two kinds of branchiæ are but modifications of the trichobranchiate type.

Scallasis,[1] n. gen.

This genus resembles *Cheramus*, but differs in the form of the eye. The ophthalmopod, or peduncle of the eye, is globular, with the eye at the extremity. Second pair of gnathopoda pediform. Posterior pair of pereiopoda minutely chelate. Branchia arranged in two rows on a stem, subcylindrical filament slightly if at all compressed. Pleopoda carry a moderately-sized stylamblys. Marginal hairs ciliated and multiarticulate.

Scallasis amboinæ, n. sp. (Pl. II. figs. 3, 4).

Carapace smooth. Rostrum small and sharp; cervical groove well defined. Telson quadrate; posterior margin slightly excavate, fringed with cilia, and having a small rudimentary pointed tooth in the median line.

Length, 12·5 mm. (half an inch).

Habitat.—Taken at Amboina, one of the Celebes Islands, on the 6th of October 1874.

The only specimen taken is very imperfect. The few limbs preserved are the anterior antenna and one of the posterior pair of pereiopoda. Therefore, in giving a description, I am compelled to refer to the only parts that have not been lost, and these may not be of great specific importance.

[1] Σκάλλω, to scrape; ἄσις, mud.

When viewed dorsally the carapace is broad, having a straight projecting rostrum extending little beyond the limit of the eyes. There is no distinct excavation or orbit to receive the eyes, but outside and beneath there is a deep notch, caused by the anterior production of the lateral or branchial walls of the carapace. From this point a deep line is prolonged backward to the posterior margin, thus indicating very distinctly, by a clearly-defined line, the part which separates the internal viscera from the external, or the gastric and cardiac regions from the branchial. There is also a deep cervical furrow connecting the lateral depressions corresponding with the posterior margin of the cardiac region, and separating it from the post-cardiac.

The pleon is about twice as long as the carapace, and has the second somite as long again as the first, the others not quite so long as the second, and subequal to each other. Telson quadrate, slightly hollowed out in the posterior margin, but the immediate centre of the excavation is occupied by a very small pointed projection or tooth, on each side of which are several short hairs, and a bunch of extremely long ones.

The ophthalmopod, or eye-stalk, is globose, almost round, with a small slightly projecting eye at the anterior extremity.

The first pair of antennæ has a long peduncle, the first two joints of which are short and the third long. The upper or inner flagellum is much stouter than the lower or outer, a feature that is generally characteristic of a male; it is about the same length as the peduncle; it is small at the base, and gradually increases in size to near the extremity, when it again rapidly decreases; the articuli are extremely short and numerous. The outer or lower flagellum is slender, and about the same length as the upper.

The second pair of antennæ has been destroyed beyond the peduncle, which reaches farther than the extremity of that of the upper.

The second pair of gnathopoda has a long and nearly straight dactylos, an equally long propodos, and short carpos; the meros is short and the ischium long, and all the joints are copiously fringed with long hairs.

The pereiopoda are wanting, except the posterior pair, which terminates in a minute chelate hand enclosed in a thick brush of hairs, some of which are ciliated on one side.

The branchial appendages consist of five posterior and six anterior arthrobranchiæ, as shown in the annexed table.

Pleurobranchiæ,	...	...	...	...	...	...	...	...	...	...
Arthrobranchiæ,	...	...	1	2	2	2	2	...		
Podobranchiæ,	...	...	...	...	...	...	...	...	...	...
Mastigobranchiæ,	...	...	...	...	...	...	...	...	...	...
	g	h	i	k	l	m	n	o		

These consist of cylindrical digitiform processes attached to a stem forming a plume, of which those at the base are long and exposed below the lateral margin of the carapace, where the extremities are visible as a row of small grape or bead-like bodies.

The pleopoda are biramose, attached to a short peduncle; the outer and larger branch springs from the side of the peduncle, the other from the apex. The outer branch is crescent-shaped, and almost encloses the inner. It is fringed on the outer or convex margin with numerous long hairs of a peculiar structure. Every hair articulates at the base by a movable joint, and beyond a short distance from its base becomes multiarticulate (*i.e.*, is broken up into numerous small sections or joints), and is fringed along the margin with short fine cilia. The inner margin of the outer plate is concave, and fringed with a few equidistant stiff straight hairs. The inner branch is fringed on each side with long pointed hairs, above which, on the side approximating the outer plate, is a row of equidistant straight stiff hairs; on the inner side is a short stylamblys, without hairs or cilia, but furnished near the apex with two rows of small blunt hooks, to which Sars has given the name of cincinnuli.

FIG. 3.—Arthrobranchia of *Scallasis amboinæ*.

The posterior pair of pleopoda, with the telson, unite to form the rhipidura or caudal fan. It consists of an extremely short base, and two broad foliaceous plates, of which the outer is larger than the inner, and both are terminally fringed with hairs.

Observations.—The jointed character of the hairs that spring from the margins of the pleopoda, as well as in *Cheramus*, are different from those in *Callianassa* both in position and structure. In *Callianassa* the outer margin is reflected on itself so as to show a smooth surface outwardly, as shown in Milne-Edwards's figure, and the hairs are all turned back and pressed against the posterior margin, and are all minutely multiarticulate. In *Cheramus* and *Scallasis* the margin is not reversed, and the hairs are broken into small joints that are suggestive of the differentiation of character, as shown in the homologous structure of *Callianidea*.

DIVISION B.

This division contains only the genus *Callianidea*, of which no species was taken by the Expedition.

DIVISION C.

This division contains the genus *Gebia*, of which no species was taken during the Voyage of the Challenger.

Family AXIIDÆ.

Dorsal surface of the carapace anteriorly produced to a horizontally flattened point or rostrum. First pair of pereiopoda large, chelate, subsymmetrical, subequal. Second

pair of pereiopoda small, chelate, symmetrical, equal; posterior pair terminating in a small styliform dactylos. First somite of the pleon shorter than the second and following. External branch of the rhipidura not longer than the inner.

A mastigobranchia present on all the pereiopoda except the posterior pair, and a podobranchia is attached to four.

This family contains the following genera:—*Axius*, *Paraxius*, *Eiconaxius*, of the first of which no specimen is in this collection.

Geographical Distribution.—*Axius* has been taken only on the southern coast of England; *Paraxius* off Celebes Island; and *Eiconaxius* south of Celebes, and near the Kermadec Islands in the West Pacific.

Paraxius, n. gen.

Characters generally resembling *Axius*, but distinguished by having the first somite of the pleon, especially in the extent of the lateral walls, much smaller than the second.

The eyes are fixed on broad bands or conical peduncles. The second pair of antennæ has neither scaphocerite nor stylocerite attached to the peduncle. The hands of the first pair of pereiopoda are broader at the dactyloid articulation than at the carpal. Telson quadrate.

Paraxius altus, n. sp. (Pl. V. fig. 1, *d–z*).

Lateral walls of the carapace deep; rostrum pointed, flattened dorsally; margins serrate. Second pair of gnathopoda with the dactylos broad and compressed, all the joints subequal in length. First pair of pereiopoda having the right propodos large, slightly narrower at the carpal than at the dactyloid joint; pollex thick at the base, sharp, pointed, curved, and smooth; a strong point or tooth at the upper distal angle of the propodos; dactylos robust, curved, pointed, smooth. Second pair of pereiopoda having the hand long, ovate; dactylos broad, thick, and obtusely pointed, of the same shape as the pollex.

Length, 25 mm. (1 inch).

Habitat.—Station 218, north of Papua, March 1, 1875; lat. 2° 33′ S., long. 144° 4′ E.; depth, 1070 fathoms; bottom, blue mud; bottom temperature, 36°·4.

Carapace about one-third the length of the animal. Compressed laterally, rather more anteriorly than posteriorly. Lateral walls deep, but not produced anteriorly in advance of the dorsal frontal margin, or posteriorly much behind the posterior dorsal margin. Rostrum flat, triangular, with an acute apex; the margins serrate, with three or four upwardly-curved teeth on each side.

First somite of the pleon short; having small coxal plates elevated into a lobe

anteriorly. The four succeeding somites are subequal and similar. They are much longer than the first, and are laterally supported by large coxal plates produced both anteriorly and posteriorly beyond the extremities of their respective somites, and rounded at their posterior and inferior angles.

The sixth somite is rather shorter and less deep laterally than the preceding, and converges dorsally towards the posterior extremity, where it supports a broad, flat telson, quadrate in form, serrate at the sides by a few sharp, small teeth, and armed with two on the dorsal surface on each side of the median line, and fringed along the posterior margin with a row of deeply-implanted plumose cilia.

The eyes are small; the ophthalmopoda conical, broad based, extending to about one-half the length of the rostrum.

The peduncle of the first pair of antennæ is cylindrical, and reaches a little beyond the extremity of the rostrum. The first joint extends beyond the eye, and has the upper surface slightly excavated to receive that organ. The second is shorter than the first, and the third is longer than the second. This last joint supports two subequally long multiarticulate slender flagella, of which the primary or upper branch is rather the shorter and the more robust; one or two long cilia originate from the extremity of each articulus.

The peduncle of the second pair of antennæ reaches beyond the extremity of the peduncle of the first, to an extent equal in length to the last joint of the second pair. There is neither spine nor scale attached to the base of this appendage, and therein it differs fundamentally from the genus *Axius* of Leach, which is described as having a movable spine.[1] The phymacerite is large, and directed inwards towards the anterior part of the metope, which recedes obliquely backwards to the mouth. The terminal joint of the peduncle supports a slender flagellum that is about one-fourth longer than those of the first pair.

The mandibles are a pair of convex plates, having the inner side concave towards the incisive or psalisiform margin, but towards the base they have a sudden enlargement or molar prominence, against which the synaphipod plays. This synaphipod arises on the anterior margin, near where it articulates with the metope; it consists of three joints, of which the distal one is the largest in width and proportions; it folds round the anterior margin of the mandible, and rests between it and the epistoma.

The first pair of gnathopoda is subpediform, that is, it somewhat resembles a pair of

[1] Leach in his Malac. Brit. says nothing about the scale (scaphocerite), but figures a rigid, sharp point at the upper extremity of the antepenultimate joint of the peduncle of the second antennæ, which he describes as "antennæ exteriores setaceæ corporis ferè longitudine." Milne-Edwards (Hist. Nat. des Crust., vol. ii. p. 311), without any illustration, says, "Le pédoncule des antennes externes présente en dessus une petite épine mobile qui représente le grand palpe lamelleux, que nous rencontrerons chez les Salicoques." Desmarest (Consid. des Crust., p. 206) makes no mention of the scale, and copies Leach's figure. Bell (Brit. Stalk-Eyed Crust., p. 227), without figure, says, "External antennæ nearly as long as the body; the peduncle furnished above with a small movable spine."

legs in general appearance, but consists of only five joints, or two less than the normal number, the coxa and basis being consolidated into one, and the dactylos absent. The second pair of gnathopoda is also subpediform, and consists of six joints, the coxa and basis being fused into one, and differs from the normal pereiopod in the form of the dactylos only. Although these two pairs are each described as being subpediform, and differing from each other only in the absence of a single joint, yet in their general appearance they vary considerably. The first joint, or coxa and basis united, in the first pair carries a mastigobranchial plate, and a slender basecphysis, consisting of a long basal joint and a terminal multiarticulate flagellum as long as the primary branch. In the second pair the first joint, or coxa and basis united, carries a basecphysis not half the length of the primary branch; besides this the mastigobranchial plate is longer and more slender, and it also supports a branchial stem carrying rudimentary papillæ. In the first pair the ischium is short, in the second it is long. In the first pair the meros is long, at least four times as long as the ischium; in the second it is scarcely so long as the ischium, and armed at the inner distal extremity with two strong teeth. The carpos in both pairs bears a corresponding resemblance, but the propodos in the first pair terminates the appendage as a semicircular terminal joint thickly fringed with hairs; in the second pair the propodos is long, cylindrical, and furnished with hairs on the lower margin, and the dactylos, which is short and rounded, ends in an obtuse point, and has the inferior margin thickly fringed with strong hairs.

The first pair of pereiopoda has the left hand wanting in our only specimen, but the right is well developed; the meros is long, and excavated beneath on the anterior portion, the inner side of which is armed with a sharp strong tooth. Into this hollow the infero-posterior portions of the carpos and propodos fall when folded back, and the prominent tooth acts as a guide to direct it to its position; the carpos is triangular, having the broad side directed forwards, against which the propodos articulates during its entire depth; the propodos is deep, but scarcely more so than the carpos at its approximate extremity, but it increases as it approaches the dactylos, the anterior upper angle is produced to a sharp-pointed tooth, the inferior angle into a long polliciform process pointed at the extremity, and curved upwards; the dactylos is about as long as the propodos is wide, it is arched on its upper margin, and terminates in a point; the lower incisive margin is nearly straight, except for a small cusp or tubercle near the middle.

The second pair of pereiopoda is much smaller than the first; it is chelate, having the hand, when the dactylos is closed against the propodos, of a long ovate form.

The third and fourth pairs of pereiopoda are longer than the second, but scarcely as robust; they have the propodos long, and the dactylos short and pointed.

The fifth pair is more feeble than either of the preceding, and appears to be reversed in its articulation with the body. It is long and slender, and terminates in a long propodos, distally tipped on the inner side with long hairs and a sharp dactylos.

The first pair of pleopoda in our specimen, which I believe to be a female, is small and feeble. The four following pairs consist of a long basisal joint supporting two multi-articulate branches, fringed at each margin with long delicately ciliated hairs. The inner branch carries on its inner margin, near its base, a single straight stylamblys.

The sixth pair of pleopoda forms the lateral plates of the rhipidura or tailpiece, and consists of a short peduncle and two large subequally broad and long plates, each having a small tooth near the outer terminal angle, while the posterior margin is fringed with a row of long ciliated hairs deeply implanted in the edge.

The branchial apparatus consists of tolerably well-developed mastigobranchiæ, to which a podobranchial plume is attached, excepting the penultimate pair of pereiopoda, where the mastigobranchial plate exists in a well-developed condition, without any branchial plume. The plumes generally consist of a stem, with two rows of cylindrical filaments. These may be formulated as follows :—

Pleurobranchiæ,	...	...	...	...	...	...	...	...	...
Arthrobranchiæ,	...	2	2	2	2	2	...		
Podobranchiæ,	...	1	1	1	1	...	...		
Mastigobranchiæ,	1	1	1	1	1	1	...		
	h	i	k	l	m	n	o		

Eiconaxius, n. gen.

Characters generally resembling *Axius*. First somite of the pleon shorter than the second. Second pair of antennæ having the peduncle furnished with a scaphocerite and stylocerite.

This genus differs from *Paraxius* in having both scaphocerite and stylocerite, which are absent in that genus; this character also separates it from *Axius*, which has a small scaphocerite only. The stylocerite, which is present in this genus, is wanting in *Axius*, as it is in all the Macrura, except *Eiconaxius* and *Cheiroplatea*. Its presence is a feature most prevalent in the Anomurous Crustacea.

Geographical Distribution.—We only know this genus as an inhabitant of the Celebes Seas, and of the Pacific Ocean near the Kermadec Islands.

Eiconaxius acutifrons (Pl. V. fig. 2, *d–q*).

Rostrum dorsally flattened and sharp pointed; narrow in the male, broad, and a little shorter in the female. First pair of pereiopoda with the right and left propoda subequal in the male, and equal in the female; compressed laterally and very deep, deeper at the posterior margin than the carpos; pollex armed on the inner side with a long, smooth, depressed tubercle, and the incisive margin beyond slightly serrated. Dactylos broad, deep, arched, and pointed, armed with a strong smooth convex tubercle near the base.

Length, 21 mm. (0·8 inch).

Habitat.—Station 194A, off Banda, September 29, 1874; lat. 4° 31′ 0″ S., long. 129° 57′ 20″ E.; depth, 360 fathoms; volcanic mud. Associated with *Cheiroplatea cenobita*.

Carapace one-third the length of the animal, laterally compressed, more so anteriorly than posteriorly; lateral walls deep, inferiorly compressed, increasing from the frontal margin obliquely backwards with an imperfect antero-inferior angle; posterior projecting a little beyond the dorsal margin of the carapace. The dorsal surface is arched a little over the gastric region, and projects forwards in the form of a flat triangular rostrum which has a slight elevation in the median line, while on the inferior surface of the rostrum, a similar but more important ridge exists as a projection between the eyes. The margins of the rostrum are smooth, except under a magnifying power, when they appear slightly serrate.

The first somite of the pleon is short and divided into an anterior depressed portion, which is capable of being covered by the carapace, and an elevated posterior portion.

The four following somites are subequally long, and support laterally large and deep coxal plates, the infero-anterior angle of which is rounded to a posteriorly directed oblique line, whereas the infero-posterior angle is produced to a sharp point which becomes less prominent on each somite posteriorly, and scarcely exists in the fifth. The sixth somite is shorter than the preceding, but nearly as broad; it has less important coxal plates, and the posterior margin is excavated to receive the articulated joint of the caudal pleopoda. The telson is square, the posterior margin being fringed with short cilia.

The eyes are small and project on each side, but do not reach beyond the base of the rostrum.

The first pair of antennæ has the peduncle extending considerably beyond the rostrum. The first joint is short, not reaching to the extremity of the rostrum, and is slightly excavated on the upper surface to receive the eye; the second joint is shorter than the first, and reaches beyond the rostrum; the third is shorter than the second, and supports two unequal flagella, the primary or upper being one-fourth longer than the lower.

The second pair of antennæ has the peduncle reaching beyond the extremity of that of the first; its third joint is externally produced to a long sharp tooth or stylocerite, between which and the base of the fourth joint stands a strong sharp movable spine, the homologue of the scaphocerite attached to the second antennæ of most Macrura—it is sharp, spine-like, and free from hairs or cilia; the fourth joint of the peduncle is very long, and reaches nearly to the extremity of the scaphocerite, whereas the fifth is shorter than the fourth, reaches beyond it, and supports a slender flagellum that makes the antennæ about half the length of the animal.

The oral appendages do not differ very materially from those of *Paraxius*. The

incisive blade of the mandible is wider and larger, and the molar protuberance within is much less conspicuous.

The first pair of gnathopoda is similarly formed to the same organ in that genus, but the basecphysis terminates in a sharp point only, instead of a multiarticulate lash.

The second pair of gnathopoda corresponds much with that of *Paraxius*, but carries a shorter and less conspicuous basecphysis, which does not terminate in a multiarticulate lash.

The first pair of pereiopoda varies but little in its relative symmetrical proportion, the organ on the right side being the larger in the male, but subequal in the female; in both sexes they are large and powerful members, and have the propodos laterally compressed and deeper than the carpos. The pollex is half the length of the propodos, and is armed with a long flat central cusp and a few small serrate teeth between it and the apex, which is sharp and turned a little upwards. The corresponding edge of the dactylos has a rounded tubercle near the joint, from which the margin continues in an unbroken wavy line to the sharp and downward curved apex.

The second pair of pereiopoda is much smaller than the first. It is chelate, the propodos is long, the margins are parallel, and the dactylos strikes the pollex obliquely. The third and fourth pairs of pereiopoda are subequal, and scarcely less robust than the second pair, they are simple in structure, and terminate each in a short, flat compressed lanceolate dactylos. The fifth is a more slender and shorter pair of appendages, but similarly constructed to the last, and supporting a small brush of hairs on the inner side at the base of the styliform dactylos.

The first pair of pleopoda is small, slender, and rudimentary in the female, and appears to be wanting in the male. The four next pairs of pleopoda are biramose, consisting of a peduncle formed of the basisal joint and two long lamelliform branches, fringed with deeply inserted long ciliated hairs. The inner branch carries, one-third from the base, a single straight stylamblys, which is armed laterally with a row of obtuse pointed curved denticles to which Sars has given the name of "cincinnuli." In the male these branches are smaller and less important, and the inner, instead of carrying one, supports two stylamblydes.

The sixth or posterior pair of pleopoda, which helps to form the rhipidura or fan-like tail, is lodged in an excavation at the external angle of the posterior margin of the sixth somite. The peduncle is short, the branches are as long as the telson, and are broad, foliaceous, and terminally fringed with cilia. The telson is as long again as the sixth somite of the pleon, it is long and rather quadrate in its form, and the terminal margin is fringed with short cilia.

The arrangement of the branchiæ shows the greatest development in connection with the three anterior pairs of pereiopoda, the number as well as the size of the plumes diminishing both anteriorly and posteriorly.

A mastigobranchia is attached to the coxa of every appendage from the posterior pair of siagnopoda, where it is very broad and short, to the fourth pair of pereiopoda, where it is long and narrow. It is slender and membranous for the distal half, the margins of which are fringed with short stiff hooks, shortest towards the apex, and gradually lengthening towards the base, where it becomes firm and rigid, and has the margins fringed with hairs.

A podobranchial plume in a rudimentary condition is attached to the base of all the mastigobranchiæ, except that of the first gnathopoda and the penultimate pereiopoda; on those belonging to the second and third pairs of pereiopoda there are a few branchial filaments attached to the base of the stem, but fewer in the third than in the second, and these gradually diminish in importance towards the distal extremity, where they exist only in the form of papilliform protuberances some distance within the extremity, which is sparsely fringed with small hooks, as shown in the annexed woodcut.

Fig. 4.—Podobranchia of *Eiconaxius acutifrons*.

These are mostly small, and so are the arthrobranchial plumes belonging to the third and fourth pairs of pereiopoda.

The branchial filaments are attached to the margins, and form the rudiment of a double row such as exists in the arthrobranchiæ, and even these latter diminish in importance and become papilliform towards the apex.

The following table shows the general arrangement of the branchia in this species :—

Pleurobranchiæ,	.	.	.	...	...	...	...	...	...	...
Arthrobranchiæ,	.	.	.	...	...	2	2	2	2	...
Podobranchiæ,	.	.	.	...	1	1	1	1	...	...
Mastigobranchiæ,	.	.	.	1	1	1	1	1	1	...
				h	i	k	l	m	n	o

Eiconaxius kermadeci, n. sp. (Pl. V. fig. 3).

Palm and propodos of the larger chela strongly denticulated, and having a hollow space between them and the dactylos.

Length, 37 mm. (1½ inch).

Habitat.—Station 171, north of the Kermadec Islands, July 15, 1874; lat. 28° 33′ S., long. 177° 50′ W.; depth, 600 fathoms; bottom, hard ground; bottom temperature, 39°·5.

This species much resembles *Eiconaxius acutifrons*, and were they found associated, would probably be mistaken for it. The rostrum is a little longer and less acutely pointed, and the margins are minutely serrate. The gastric region is more distinctly defined by a ridge from the frontal; but a more noticeable distinction exists in the form

of the armature of the large pair of chelate pereiopoda, which exhibits a large hollow space between the impinging margins of the pollex and the closed dactylos. Even here the male and female differ somewhat. In both sexes the left propodos is larger than the right. The right hand in both is similar; it is narrower, less serrate, and has the dactylos and the pollex correspondingly impinging throughout their entire length, being quite half as long as the propodos, whereas on the left side the propodos is two-thirds longer than the dactylos, and so broad that it impinges against the antagonising process of the propodos in an oblique direction at the apex, leaving a large open space between it and the base, the propodal margin of which is serrate with several large teeth, whereas that of the dactylos is smooth.

The second pair of pereiopoda has the propodos long and narrow, not very unlike but more slender than that of the previous species.

The fifth or posterior pair is quite as robust as that of the fourth, but has the infra-terminal angle of the propodos fringed with a brush of rather long cilia.

The females were carrying ova, which were very large, and numbered about twenty, but were not sufficiently advanced to enable me to determine the character of the embryo.

Eiconaxius parvus, n. sp. (Pl. V. figs. 4, 5).

Like *Eiconaxius acutifrons*, except in having the impinging surfaces of the dactylos and dactyloid process of the propodos, of the first pair of pereiopoda, smooth.

Length, 12 mm. (0·5 inch).

Habitat.—Station 170, off the Kermadec Islands, July 14, 1874; lat. 29° 55′ S., long. 178° 14′ W.; depth, 520 fathoms; bottom, volcanic mud; bottom temperature, 43°.

This species is distinguishable from the preceding by having the left or larger hand without any teeth on the impinging margins of the dactylos, and pollex or projecting process of the propodos. By the rather long and less lanceolate form of the dactylos on the three posterior pairs of pereiopoda, and by the less pointed and tooth-like appearance of the infero-posterior angle of the coxal plates of the pleon.

There was but one specimen of this species taken, and that a female, which is rather smaller than those of the females of the preceding species.

Observations.—There were seven ova attached to our specimen. These, when compared with the size of the animal, were extremely large. They were oval rather than round in shape, and measured about 1 mm. in length. Fortunately they were approaching the period when the embryo is ready to leave the ovum; but having been preserved in spirits, the vitelline substance had been unfortunately rendered so opaque that without the assistance of reagents there was little to be determined with accuracy. But with their assistance, and careful manipulation, I was enabled to take out of the ovum a

young animal that very closely resembled the brephalos of the genus *Homarus* under the same condition. I say very closely, but there are some important points of distinction, which may best be appreciated by comparing the following description of the embryo of the present species with that of the young of our common lobster.

The carapace is circular, and extends over the pereion to the last somite. The rostrum is wanting. The eyes are small, almost minute. The first pair of antennæ is two-branched, one ramus being stout, the other slender, and both nearly of one length. The second is also double-branched; one ramus short, the other long; the short ramus represents the permanent scaphocerite of the adult animal, the other the long flagellum, which is twice the length of that of the anterior pair, and reaches to the posterior extremity of the carapace. The mandibles are present, and are approaching their mature form. The incisive blade has scarcely reached its full proportion, which gives to the synaphipod a large and somewhat pediform appearance. The three succeeding pairs of oral appendages are visible, and approximating to their adult forms.

The two pairs of gnathopoda are simply pediform, each furnished with a strong basecphysis (or branch sprouting from the basisal joint). The second pair differs from the first in having the basecphysis of the same length as the primary branch, whereas in the first the primary or main branch is shorter than its basecphysis.

The first pair of pereiopoda has well-developed chelæ; the right and left, being uniform in shape and size, correspond in form with the right or smaller hand in the adult.

The second pair of pereiopoda is also chelate, but much smaller in size, and corresponds closely in form with that of the adult. Neither this nor the preceding pair has an ecphysis attached. The three posterior pairs of pereiopoda are simple, and approximate to the adult character; to these an ecphysis is attached, although the branchial appendages are not present on any of the limbs, unless a small bud-like process attached to the coxa of the second pair of gnathopoda may be so interpreted.

The first pair of pleopoda appears to be wanting, as in the adult female. The four following pairs are developed as long double-branched appendages surmounting a long stalk. The inner branch, as in the adult female, carries on the margin a small stylamblys, except on the fourth pair. The posterior pair of pleopoda, which ultimately becomes developed into the large side plates of the rhipidura or fan-like tail, differs from the four preceding pairs in having the branches large and the basisal joint short, and in carrying no stylamblys on the margin of the inner branch.

The telson is long and broad, reaching to beyond the posterior pleopoda for about one-half their length.

At the period of my examination the various hairs with which the animal is furnished on the several parts of the body were wanting. Evidence of their existence is present, but as they, until the animal has been hatched, and lives freely in the sea for a few hours, invariably remain enclosed within their respective points of attachment, they

are only capable of being detected where they are largest and most important, such as at the extremity of the ecphysis of the gnathopoda, and at the posterior margin of the telson.

Comparing the brephalos with that of *Homarus*, we find that it has the antennæ further advanced in development, that there is no ecphysis attached to the first and second pairs of pereiopoda, and that all the pleopoda are well advanced in development, whereas in *Homarus* the pleopoda are all wanting. An ecphysis is attached to the basis of the several pairs of pereipoda, and the flagella of both pairs of antennæ are in a rudimentary condition.

The carapace in both is small, covering only the pereion.

We thus perceive that although the resemblance between them is great, particularly in relation to the cephalon and pereion, a difference exists in the more advanced condition of the brephalos of *Eiconaxius* at the period when it quits the ovum, as compared with the young of *Homarus*.

In each of these genera the ova are extremely large, and few in number.

Family THAUMASTOCHELIDÆ.

The carapace is ovate and smooth, and projects to an anteriorly-flattened point or rostrum. The first pair of antennæ has two long flagella, and the second has a well-formed scaphocerite. First pair of pereiopoda is chelate, large, having a long slender dactylos and pollex; subequal, somewhat unsymmetrical. Second pair chelate, symmetrical, subequal, small. Pleon has the coxal plates well defined. Rhipidura having the outer plates much larger than the inner. Branchial apparatus having a mastigobranchia attached to all the appendages of the pereion, except the first pair of gnathopoda, where it is rudimentary, and the posterior pair of pereiopoda; five podobranchiæ, ten arthrobranchiæ, and four pleurobranchiæ on each side.

The genera in this family are *Thaumastocheles* and *Callocaris*.

Thaumastocheles, Wood-Mason.

Astacus, Suhm, Trans. Linn. Soc. Lond., ser. 2, vol. i. p. 48.
Thaumastocheles, Wood-Mason, Proc. Asiat. Soc. Bengal, p. 181, 1874.

Carapace less than half the length of the animal, dorsally flattened and anteriorly produced to a rostrum, divided by a moderately deep cervical sulcus; near the centre the lateral walls are depressed and the posterior margin is secured in its position by a strong blunt process (pleocleis) attached to the lateral portion of the first joint of the pleon.

The pleon is longer than the carapace, and each somite increases in width posteriorly to the fifth and then decreases.

The ophthalmopoda are absent or obsolete.

The first pair of antennæ terminates in two long, slender subequal flagella.

The second pair of antennæ has a short and stiff scaphocerite, and terminates in a long slender flagellum.

The siagon or mandible is strong, and carries a three-jointed synaphipod.

The posterior siagnopod has the distal extremity of the outer branch formed into an operculum, and the mastigobranchia is broad and well developed.

The first pair of gnathopoda has neither branchial plume nor mastigobranchia, but a rudimentary stump alone represents the latter.

The second pair of gnathopoda supports a basecphysis, a well-formed podobranchial plume and well-developed mastigobranchia.

The three anterior pairs of pereiopoda are chelate, the first pair being much larger than the others, the pollex and dactylos being longer than the propodos, although unequal in proportion on each side. The fourth pair is monodactyle, the dactylos short and hairy. The fifth or posterior pair is minutely chelate, the dactylos being very small and lost amongst a brush of hairs in the only specimen procured. But as this description is taken from a female, it is not improbable that this may be a sexual rather than a generic character.

The form of the rhipidura, the length and increasing width of each posterior somite of the pleon, and the form and character of the pereiopoda approximate the character of this genus to *Axius* and others of the Thalassinidæ.

Thaumastocheles zaleuca (v. Willemoes-Suhm) (Pl. VI. *b–q*; Pl. VII. fig. 1, *e–h*).

Astacus zaleucus, Willemoes-Suhm, Trans. Linn. Soc. Lond., ser. 2, vol. i. p. 49, pl. x. fig. 1.
Thaumastocheles zaleuca, Wood-Mason, Proc. Asiat. Soc. Bengal, p. 181, 1874.

Animal long and slender, sides subparallel and compressed, dorsal surface smooth except on the antennal and post-ocular regions of the carapace, on each side of the rostrum, and the third and fourth somites of the pleon, where there are numerous short, thick tufts of hair.

Rostrum dorsally flat. Ophthalmopoda absent. First pair of antennæ subequally biramose. Second about as long as the animal and carrying a strongly serrated scaphocerite, first pair of pereiopoda asymmetrical. The right being the larger and furnished with a pollex and dactylos, nearly as long as the animal, slender and rod-like, curving towards each other at the extremity, and armed on the inner surface from base to apex with long spine-like teeth that interlock with each other when closed.

Rhipidura having the outer plate large and strong and the inner small. Telson quadrate.

Length, 100 mm. (4 inches).

Habitat.—Station 23, off Sombrero Island, West Indies, March 15, 1873; lat. 18° 24′ N., long. 63° 28′ W.; depth, 450 fathoms; bottom, Pteropod ooze.

The carapace, measuring from the extremity of the rostrum to the posterior margin of the central dorsal surface, is rather more than one-third of the entire length of the animal. The rostrum is dorsally flat and projects as far as the distal extremity of the second joint of the first pair of antennæ, the extremity is pointed and curved upwards, and the lateral margins are fringed with hairs and a few (four) short, sharp teeth on each side. The carapace is divided near the centre by a deep cervical sulcus, and the lateral walls are almost perpendicular, and cover and protect the entire branchial apparatus.

The first somite of the pleon is large and divided into an anterior and a posterior portion. The anterior is smooth, and when the animal is fully extended passes beneath the carapace; the posterior is also smooth but somewhat elevated, and increases at the lateral margins to a ridge that defines the limit between the somite and the coxal plate, which is associated with it; this ridge projects forwards into a small process, or pleocleis, that overrides and assists in keeping the posterior margin of the carapace in position. A line of hairs which fringes the posterior margin of the carapace dies out where the lateral process projects, and commences at the corresponding point on the anterior margin and traverses that of the coxal plate of the first somite of the pleon.

The second somite is dorsally quadrate, but is a little broader at the posterior margin than at the anterior, the lateral crests are well defined and denticulate, the coxal plate is perpendicular, and the infero-lateral margin rounded at the anterior and posterior angles, smooth on the outer surface, but fringed with a row of thickly-set hairs on the inner.

The third somite resembles the previous one, except that instead of being smooth it is extensively covered with thick, short hairs. The lateral crests or ridges are smooth, the small denticulations on the previous somite being but feebly represented.

The fourth resembles the third, but is slightly broader, and equals the breadth of the carapace; the coxal plates, instead of being smooth, are thickly covered with hair on the outer surface towards the postero-inferior angle.

The fifth somite is somewhat narrower than the fourth, and is slightly broader at the posterior than at the anterior margin. The dorsal surface is smooth, and the coxal plate has a tendency to turn obliquely outwards, and has a brush of hair at the postero-inferior surface.

The sixth somite is quadrate, but longer and narrower than the fifth. The coxal plate is less deep than the preceding, and narrows posteriorly.

The seventh somite or telson is square, flat, and posteriorly fringed with a row of closely-planted hairs.

The eyes are absent. The metope is smooth, polished, and submembranous. Two small but prominent tubercles tipped with hairs stand on each side of the median line, and above where the eye should have been the margin of the carapace is slightly excavated to form an orbit.

The first pair of antennæ consists of a three-jointed peduncle and two long subequal flagella. The first or coxal joint is longer and larger than the two succeeding, and

articulates with the metope by a strong, smooth, nodular tubercle, visible on the upper surface at the outer angle of the antennæ, near which a slight opening defines the passage to the auditory apparatus; the two succeeding joints are short and narrow, but the third is longer than the second; the flagella are of the same length and size, both being fringed with long, fine, sparsely-planted hairs, among which I have not been able to detect any of those membranous organs that I believe to be auditory cilia.

The second pair of antennæ has a peduncle longer than that of the first. The first joint is short and wide, and supports a large wide-mouthed phymacerite; the second joint is as broad as and longer than the first, particularly at the anterior margin, where, on the inner side, it is produced forwards to a strong point, while the scaphocerite articulates on the outer side. This latter is a stiff curved appendage, smooth on the outer side, and denticulate with several sharp, strong teeth on the inner and distal margins; the joint which supports this appendage is firmly anchylosed with the preceding, but may be determined by a well-defined line marking the boundary between the two; the terminal joint is long and narrow, reaching to the extremity of the peduncle of the upper antennæ, and the flagellum is robust and long, equal to the length of the entire animal.

The siagon or mandible is large, broad, strongly denticulate on the incisive margin, and furnished with a narrow molar ridge on the inner surface; the synaphipod has two joints, of which the first is curved, the second straight but articulated at a right angle to the rest of the appendage; it is directed beneath and within the oral apparatus, and impinges against the molar ridge on the underside.

The first pair of siagnopoda (Pl. VII. fig. 1, *e*) has three branches; the inner one is directed laterally inwards, thin, narrow, and tipped with stiff hairs; the second is directed forwards and inwards, narrow at the base, and wide at the extremity, and fringed with spines and short hairs; the third is two-jointed: the first joint is narrow, strong, and directed forward; the second is slender, whip-like, and directed outwards. The whole organ presses closely against the under surface of the mandible; near the outer basal margin is a thick bunch of ciliated hairs.

The second pair of siagnopoda (*f*) consists of three foliaceous and one styloid branch, together with a short, rounded mastigobranchial plate; the outermost plate which is an anterior prolongation of the mastigobranchia is foliaceous, long, narrow, and thickly fringed with short plumose hairs on the apical and inner margins; the second is styloid, fringed with a few hairs on the outer margin near the base, after which it is smooth, and terminates in a sharp point curved slightly inwards; the next branch is biramose, the outer ramus being the larger, is foliaceous and terminates in a fringe of thick, strong teeth and a few fine hairs; the inner ramus is similar but narrower; the fourth or innermost plate is biramose like the preceding, and resembles it in its foliaceous character, but is rather smaller. The mastigobranchia is flat, thick, and fringed with short plumose hairs.

The third pair of siagnopoda (*g*) consists of three foliaceous branches, and a

large mastigobranchial plate. The outer branch consists of two joints, the basal one, which is long, narrow and sub-foliaceous, is fringed on the outer margin, and supports a second joint at its extremity, the plane of which is at right angles to that of the basal joint; this second joint is long, ovate, and thickly fringed with hairs; in its position it rests as an operculum against, and covers the outer and anterior outlet of the branchial chamber: the second or middle branch stands at right angles with the preceding, it is as long as the first joint of the previous branch, strong, foliaceous, and thickly covered with hairs: the third or inner branch is shorter and broader than the preceding, it is concave inwards and convex outwards, delicately foliaceous, and fringed with hairs, most abundantly on the inner margin. The mastigobranchia which is directed posteriorly is as long as the first branch, it is broad, thin, and studded over with numerous long hairs; on the outer margin, near the base, is a small process that may be the abortive rudiment of a branchia.

The first pair of gnathopoda (*h*) is subpediform; it consists only of six joints. The first or coxal joint supports a strong process thickly fringed with hairs, which appears to be an obsolete or depauperised mastigobranchial plate: the second joint or basis supports an ecphysis of two joints, or rather of one joint and a multiarticulate lash fringed with hairs: the third joint is probably the ischium and meros combined, and is tolerably long, three times as long as the basis; it is broader near the base than at the distal extremity, where it articulates diagonally with the next joint, which I consider to be the carpos; it is narrow at the proximal and broad at the distal extremity, where it is fringed both on the inner and outer side with a thick brush of hairs: the penultimate I take to be the propodos; it is narrower at the base than at the distal extremity, where it is thickly fringed with long hairs, and in the centre is deeply excavate, and articulates with the dactylos in the form of a flat ovate plate, tipped with strong hairs.

The second pair of gnathopoda (Pl. VI. *i*) is much larger than the first, and proportionately more slender. It is pediform, and consists of seven joints. The coxa carries a well-formed mastigobranchial plate, that supports a well-formed but not long podobranchial plume; the basis is short, and supports an ecphysis consisting of a single joint, which nearly equals the ischium in length, and terminates in a multiarticulate flagellum; the ischium is three-sided, flattened, the inner and outer margins parallel, the outer smooth, corresponding with the basecphysis, the upper or central is denticulate and hairless, but the lower or inner is fringed with long hairs; the meros is united with the ischium by an articulation, and corresponds with it in form as well as in armature, but is rather longer; the carpos is about half the length of the meros, and articulates with it at the extremity, the inner side is triangular, and has each margin fringed with long hairs; the propodos is of about the same length as the carpos, three-sided, with sub-parallel margins; each side, particularly the inner as well as the margins, is covered with numerous long hairs; the dactylos is of about the same length as the

propodos; the sides are curved, gradually converging to a point, and covered plentifully with long hairs.

The first pair of pereiopoda is asymmetrical both in size and form. That on the right side has a short ischium, convex on the outer side, and flat or concave on the inner. The upper ridge is produced into a backwardly-directed process that overlaps and plays round the neck of an anteriorly directed nodule on the basis (Pl. VI. *k'''*). The meros is flattened vertically, and has but two margins, except near the carpal joint, where it is thickened and has three; the carpos is short and nodular, and articulates on the infero-exterior angle of the meros; the propodos articulates on the infero-anterior angle of the carpos; it consists of a double ovate mass, placed side by side, one division of which only (the upper or anterior) articulates with the carpos, the other is rounded posteriorly; a deep constriction on either side anteriorly separates this body of the propodos from the digital extremity, which is prolonged into a very long, slender pollex, flattened vertically to the plane or surface of the propodos; it is curved at the distal extremity into a long and slender sharp tooth, and armed in its entire length with a series of long, slender teeth, intermingled with shorter ones of the same character. These are regularly planted, some directed obliquely inwards, the others outwards, on the entire length of the pollex. The dactylos closely resembles the pollex both in form and size, and when the two are compressed together, the long, slender teeth are interlocked together very regularly. On the left side the carpos is short, but less bulbous than on the right. The propodos is narrow and long, having the margins parallel, the under side smooth, and the upper surface minutely spinous as far as the base of the pollex, which is but a little longer than the palm; the dactylos resembles the pollex closely, and is a modified type of the right appendage; it is smooth on the outer side, and fringed with a series of delicate teeth, that interlock with similar ones on the inner margin of the pollex.

The second pair of pereiopoda is nearly as long as the first, not including the dactylos, but is much more slender and chelate. The propodos and carpos are subequal, and the dactylos and pollex are short, not being half the length of the propodos, which latter is not wider than the carpos, and has the inferior and superior margins parallel.

The third pair of pereiopoda very closely resembles the second, but is smaller as a whole.

The fourth pair is still shorter, and differs chiefly in being mono-dactyle, the pollex being absent, or existing only as an unimportant angle of the propodos, much imbedded in fur.

The fifth pair equals the preceding in size and length, but terminates in a minute and perfect chela buried in a thick brush of fur.

The first pair of pleopoda is small, slender, and terminates in a single hairless branch.

The second and three succeeding pairs are short and robust, and carry two narrow

foliaceous plates, of which the inner is the larger, and exhibits a notch, from which a bundle of long hairs projects, but no stylamblys is apparent.

The sixth pair of pereiopoda forms part of the rhipidura or caudal fan. It articulates with the posterior angle of the sixth somite; the basal joint is short and broad, and carries two sub-foliaceous plates; the external is large, triangular, narrow at the base, and broad at the extremity, the outer side is the longest, and projects forwards; a diæresis marks the external distal portion, but does not traverse the breadth of the plate, which is strengthened in the middle by a longitudinal ridge; the inner plate is much smaller than the outer, and like it is traversed by a longitudinal ridge, and both are fringed along the distal margins with closely-set hairs; the external plate has a similar row along the line of diæresis.

The specimen above described was taken in the dredge off Sombrero Island, in about 450 fathoms of water, on a bottom of Globigerina ooze. There is only one perfect specimen in the collection, but fragments of a second, consisting of the gnathopod and first pair of pereiopoda, appear to be parts of a more spinous variety, perhaps those of a male form.

The branchial arrangement of this species may be tabulated as—

Pleurobranchiæ,	.	.	...	...	...	...	1	1	1	1
Arthrobranchiæ,	.	.	...	...	2	2	2	2	2	...
Podobranchiæ, .	.	.	...	...	1	1	1	1	1	...
Mastigobranchiæ,	.	.	...	1	1	1	1	1	1	...
				h	i	k	l	m	n	o

The branchial appendages are generally long. The podobranchiæ are the longest, and almost entirely cover and protect the arthrobranchiæ and pleurobranchiæ, particularly those of the four anterior pairs of pereiopoda. The mastigobranchiæ form inter-branchial plates similar to those of the *Homarides;* they are long and broad, reach to the extreme length of the branchial plumes, and are sparingly covered all over with long hairs that spread out and penetrate between the branchial filaments. The hairs are generally smooth and pointed. The inner surface of the carapace that covers the branchial chamber is similarly beset with hairs of the same kind, this, with the mastigobranchial plates, and pleura or floor of the branchial chamber, forms a division in which the several branchiæ of each appendage are shut off from the rest (Pl. VII. fig. 1, 1*br*); the pleurobranchia lies beneath and rests upon the floor of the chamber, the arthrobranchiæ meet in the centre, one on each side above the pleurobranchia, by a single row of short filaments that nearly touch each other at their extremities; the podobranchia covers and overlaps the whole, while long, slender, and somewhat stiff hairs play between the several plumes of the branchiæ, as well as between the numerous filaments that compose them, and probably keep the whole of the complex structure in constant motion.

The posterior pair of periopoda possesses no podobranchia, arthrobranchia, nor

mastigobranchia, and the pleurobranchia, which is well developed, is implanted high upon the pleura, and is directed anteriorly, lying nearly horizontally beneath the carapace.

In the three next anterior pairs of appendages the pleurobranchia is implanted much lower, and traverses the same line as the overlying podobranchia. The first pair of pereiopoda has no pleurobranchia, nor has the second pair of gnathopoda, while the first pair (Pl. VII. fig. 1, *h*) has no branchial plume whatever, and the mastigobranchia is reduced to a rudimentary stump, fringed with a thick brush of hair.

The third pair of siagnopoda (Pl. VII. fig. 1, *g*) supports a broad and tolerably long mastigobranchia, to which is attached, on the upper margin near the base, a small styliform process, fringed with ciliated hairs on one side and simple ones on the other. This organ I take to be the rudimentary homologue of a podobranchial plume. On the second pair of siagnopoda the mastigobranchia is also present, and is large, broad, and rounded at the apex; the margin fringed with short posteriorly-directed plumes or hairs.

The entire branchial apparatus corresponds very closely with that of *Phoberus*, and resembles in general structure that of the Palinuridæ.

Observations.—Thaumastocheles zaleuca is a blind species, and most probably fossorial in its habits. That it is a degraded form I think we may safely infer from the excavations which correspond with the orbits still remaining in the anterior margin of the carapace, as well as from the depressions in the first pair of antennæ, such as exist in those specimens in which the ophthalmopoda are well-developed.

The metope is a smooth perpendicular plate, bearing two small tubercles tipped with a small brush of hair that projects from the surface immediately on each side of the median line. The general appearance of the metope is sub-membranous and translucent, and it is highly probable that the optic nerve terminates so closely behind it as to receive impressions of light, although probably of a very subdued character, as in the subterranean Amphipoda. The assumption that there is consciousness of light appears to receive support from the extent of surface which the metope occupies (Pl. VI., c″), and the depressed position of the first pair of antennæ.

The first pair of antennæ lies inside the second pair and in the same line with it; the upper surface is excavated as if it had been so formed to admit of the presence of a large pedunculated eye, which has disappeared. At the lower part of the metope and just above the attachment of the first pair of antennæ the small, fixed, rounded and polished tubercles, very close to but not associated with the articulation of the antennæ, may be the remains of the peduncle of the obsolete eye; but this is only suggested, because I do not remember to have observed similar tubercles in any form of Crustacea where the ophthalmopoda are developed.

The idea of this species being more or less fossorial in character is suggested by several anatomical conditions: the blindness of the animal; the operculum at the anterior passage of the branchial chamber; the strong pleocleis on the first somite of the pleon,

that compresses and holds down the posterior margin of the carapace; the short fur on the post-orbital regions, extending on each side of the gastric region of the carapace, and repeated on the third and fourth somites of the pleon; and the strength, and more particularly the form of the several parts of the rhipidura or tail-fan, which is formed by the sixth pair of pleopoda and the telson.

The sixth pair of pleopoda is implanted on the ventral surface within the margin of the coxal plate and is directed anteriorly, and the outer plate is very much longer than the inner, and possesses a diæresis near its distal extremity. Although the outer or anterior plate is very much longer than the posterior, yet the latter equals the length of the posterior margin of the former, and their distal margins form a continuous line. The telson is quadrate, and the terminal or distal margin when depressed a little forwards is continuous with the posterior margin of the rami of the sixth pair of pleopoda, and this is capable of resting through its entire length against the floor on which the animal lies, and so enables it to creep backwards with considerable persistence and power.

The large chelate pereiopoda differ on each side; each is furnished with long delicate spine-like teeth, but that on the left shows most probably the character and appearance of the normal chela, while that on the right exhibits an extensive deviation. The propodos has increased in size as a consequence of the powerful muscles necessary to sustain and carry the enormously long dactylos and pollex, which nearly equal the entire length of the animal; the form of the chela is that of two combs meeting, and it appears probable that when partially closed it has the power of raking the neighbourhood to a considerable distance, and so entrapping small animals and other material from which the blind creature has the power of selecting its food, which it carries to its mouth by means of its smaller chelate pereiopoda, the larger ones from their length being incapable of that office. The mouth is furnished with a pair of powerful denticulated mandibles, that are evidently capable of crushing tolerably hard substances. The anterior lip is calcified, firm, and denticulate on the antero-external margin (Pl. VI. fig. *c*). The epistoma is horizontal or nearly so, and occupies a considerable space between the antennæ and the mouth, separating the phymacerite to a considerable distance from it. The phymacerite is very large, and is situated on the first or coxal joint of the second or outer pair of antennæ, which is short, broad, and separated from the body by a distinct suture.

This animal is intermediate in character between *Thalassina* and the Astacidæ, to which latter family Willemoes-Suhm first referred it under the name of *Astacus zaleucus*. Its nearest congener appears to be *Calocaris*, Bell, of the British seas, from which it differs in the third pair of pereiopoda being minutely chelate instead of monodactyle, and in having no apparent organs of vision, instead of, as in *Calocaris*, having the "eyes rudimentary, sub-globose, without any pigment or cornea," which, when Bell described it in 1853, was a feature "unique in the whole of the higher forms of Crustacea." *Calocaris*

was first taken from the stomach of a flat fish by Mr. W. Thomson, and in 1845 by MacAndrew and Professor Forbes in Loch Fyne, at a depth of 80 fathoms, and more recently (1869) by G. O. Sars, in 150 fathoms of water, in several places off the coast of Norway,[1] in which situation it is fossorial in sandy mud. Living at such a depth, and being of fossorial habits, distinct vision would be useless, and this at once accounts for the rudimentary character of its eyes, the colour of which is entirely white. "The general colour [of the animal] is a delicate pink or pale rose, varying in depth in different parts."

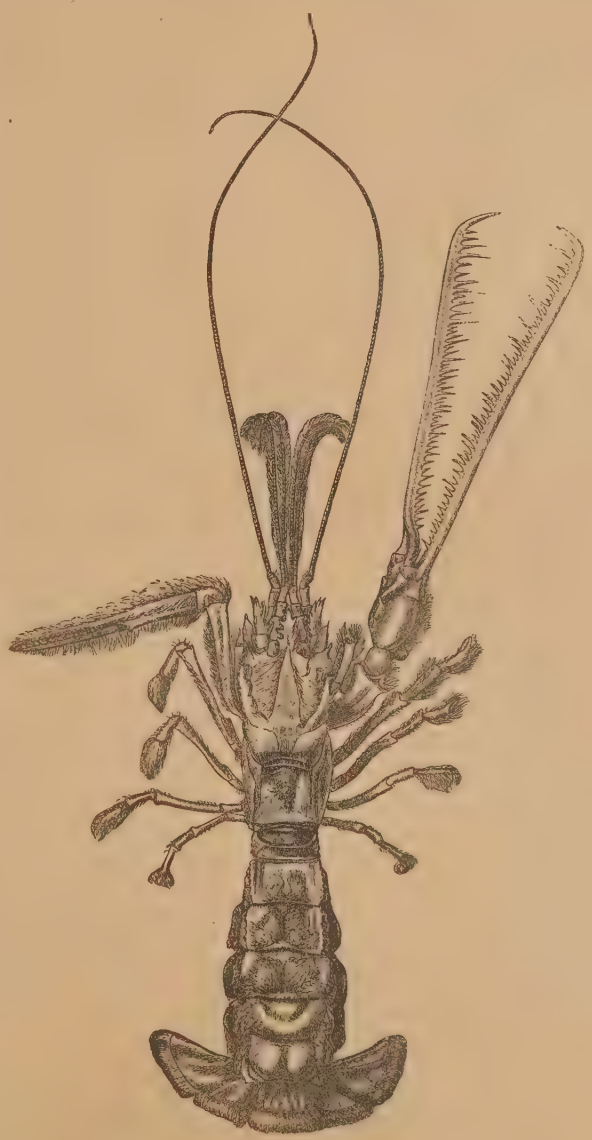

FIG. 4A.—*Thaumastochleles zaleuca*, from a drawing by Dr. v. Willemoes-Suhm (natural size).

Dr. v. Willemoes-Suhm in his account of *Thaumastocheles* (*loc. cit.*, p. 50), says: "*A. zaleucus*, came up on the swabs of the dredge, together with the large chelæ of another smaller specimen, the body of which was lost. The one we got had the red colour of all deep-sea Crustacea. It lived on a bottom of Globigerine ooze, evidently frequented by a great many animals. Several Sponges and seven Echinoderms (*Ophiomusium*, *Luidia*, *Archaster*, *Astrogonium*, *Cidaris*, and *Echinus*), a *Planularia*, *Mopsea*, and an *Isis*, several Annelids, and a *Sipunculus*, a *Galathea*, a Peneid, an *Arcturus*, and the fine Crustacean, to which was given the name of *Willemœsia crucifera*,—four Bryozoa, a *Dentalium*, and many small shells—finally, a fish probably belonging to the genus *Chauliodus*, were got in the same place with this extraordinary *Astacus*. Unfortunately, our stay in the West Indies was only a very short one. The few hauls, however, which we had near Sombrero Island and St. Thomas showed us that a great quantity of new and probably also interesting animals live there in moderate depths (300 to 400 fathoms)."

The specimen is a female, but without any ova attached.

[1] Undersögelser over Hardangerfjordens Fauna; 1 Crustacea, af G. O. Sars (*Oversigt K. D. Vid. Selsk. Forhandl.*, 1871).

Group NORMALIA.

This group consists of those Trichobranchiate Macrura in which the branchiæ are well developed, and the pleon does not preponderate in importance over the carapace.

It consists of three tribes, that present peculiarly distinctive features, illustrated in their external form, their structural character, and development, as shown in the subjoined table :—

	Tribe.	Family.	Genus.	Brephalos.
NORMALIA.	Synaxidea,	Scyllaridæ,	*Ibaccus.* *Paribaccus.* *Pseudibaccus.* *Thenus.* *Scyllarus.* *Arctus.*	Phyllosoma.
		Palinuridæ,	*Linuparis.* *Panulirus.* *Palinurus.* *Palinostus.* *Synaxes.*	
	Astacidea,	Eryonidæ,	*Eryon.* *Eryoneicus.* *Eryonasticus.* *Polycheles.* *Pentacheles.* *Stereomastis.* *Willemœsia.*	Megalopa.
		Homaridæ,	*Phoberus.* *Nephropsis.* *Nephrops.* *Homarus.*	
		Astacidæ,	*Cambarus.* *Astacus.* *Astacoides.* *Parastacus.* *Paranephrops.* *Astacopsis.* *Engæus.* *Cherops.*	
	Stenopidea,	Stenopidæ,	*Stenopus.* *Spongicola.*	Zoea.

Tribe **Synaxidea.**

Branchiæ well developed, having mastigobranchial plates attached to all the pereiopoda except the posterior pair. Podobranchia attached to all the mastigobranchiæ as distinct plumes. Arthrobranchiæ attached to the joints of all the pereiopoda, and pleurobranchiæ to the walls of the four posterior somites of the pereion. First pair of antennæ terminating in two flagella. Second pair without any scaphocerite. Pereiopoda six-jointed, having no perfect chela. First pair of pereiopoda, but little larger than the

second, sub-chelate, the pollex never being produced beyond the length of the dactylos. The three following pairs monodactyle or imperfectly chelate. The posterior pair is more or less minutely chelate in the female, and monodactyle in the male.

This tribe consists of genera that differ widely in their external aspect, but are closely associated in structural affinities and development. Some are dorsally depressed, others are laterally compressed. Some have the ophthalmopoda projecting on an advanced somite, others have them lodged in orbits excavated in the frontal margin of the carapace. Some have the second pair of antennæ long and slender, while others have them reduced to a short discoid plate.

But they all agree in the following points:—the character of the branchiæ, the absence of a scaphocerite attached to the second pair of antennæ, in having only six joints to the pereiopoda, in having no true chela, in having the ova very small, and in the Phyllosoma condition of the brephalos. The examination of an undescribed form which I have named *Synaxes*,[1] in which several features of these two families are combined, has induced me to arrange them all under one head. *Synaxes* has the antennæ of *Palinurus*, while the pereiopoda are like those of *Scyllarus*, the carapace is like that of *Astacus*, and the pleopoda like those of *Scyllarus*. Having no means of knowing the character of the brephalos when it quits the ovum, and as both *Palinurus* and the Scyllariform genera have the young hatched in the megalopa stage, resembling Phyllosoma, I am induced, until future observation demonstrates the fact, to believe that the brephalos of *Synaxes* also resembles Phyllosoma. I therefore follow the arrangement of previous authors and place the tribe under two families, into which it naturally divides, Scyllaridæ and Palinuridæ.

Family Scyllaridæ.

Carapace horizontally depressed. Eyes implanted in orbits excavated in the dorsal surface of the cephalon. Second pair of antennæ short, squamiform. The mandibles bearing a uniarticulate synaphipod. Pereiopoda simple, excepting the posterior pair of the female which is minutely chelate.

Ibaccus, Leach.

Geographical Distribution.—Ibaccus incisus has been recorded from New Holland and the adjacent seas; *Ibaccus antarcticus* from Japan and the coasts of Asia; and *Ibaccus parræ* from the Antilles. Stimpson found *Ibaccus novemdentatus* at Hong Kong. De Haan obtained *Ibaccus ciliatus* from Japan. *Ibaccus brevipes* was taken south of New Guinea; *Ibaccus alticrenatus* off New Zealand, and *Ibaccus verdi* was taken in the Atlantic.

No specimen of this genus, so far as I am aware, has ever been found fossil.

[1] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. vii. p. 220, pl. xiv.

Ibaccus verdi, n. sp. (Pl. VII. fig. 2; Pl. VIII.).

This species bears a general resemblance to *Ibaccus incisus* (Péron) (*Ibaccus peronii*, Leach), but has the lateral margins of the carapace armed with seventeen teeth posterior to the cervical notch, and two small teeth on the angular cusp anterior to it. There are six teeth along the lateral margin of the third antennal joint, which does not slope inwardly so much as in *Ibaccus incisus*. The terminal scale has the distal margin fringed with nine strong short teeth in the female. In most other important points this species nearly resembles *Ibaccus incisus*.

The male differs from the female in having the distal margin of the terminal scale of the second antennæ smooth or slightly wavy, and in having the posterior pair of pereiopoda terminating in a sharp pointed lanceolate dactylos (Pl. VIII. fig. *o*, ♂), whereas in the female the dactylos is short (fig. *o*, ♀), and impinges against a short and robust pollex, entirely wanting in the male.

The pleopoda also differ very much in the two sexes.

In the male none are attached to the anterior somite, but the four succeeding have a pair each, successively diminishing posteriorly (Pl. VIII. figs. *p* and *q*, ♂). They consist of two branches, flat, narrow, curved, and pointed, the outer branch being sharper than the inner, and more distinctly defined in the posterior than in the anterior pairs. The branches are not on the same line, but the inner articulates at the apex, and the outer laterally with the basal joint. The margins of both branches are fringed with numerous hairs that are longer and more abundant on the anterior pairs than on the posterior.

The female, like the male, has no appendage attached to the first somite of the pleon; the second (Pl. VIII. fig. *q*, ♀) bears a pair of large two-branched foliaceous plates, standing on small stalks. The three following pairs are likewise two-branched, but the outer branch is small and foliaceous, articulating with the stem near its base, whereas the inner is three-jointed, long, narrow, stiff, and articulates with the stem at the extremity, except for the slight squamose extension at its base. These are fringed with very long hairs, much longer than shown in the plate.

Habitat.—St. Vincent, Cape Verde Islands, July 1873, depth 7 to 20 fathoms. Length,[1] 130 mm. (5·25 inches).

Station 200, off Samboangan, Philippine Islands, October 23, 1874; lat. 6° 47′ N., long. 122° 28′ E.; depth, 250 fathoms; green mud. Length, 114 mm. (4·25 inches).

Although several species of this genus have long been known, it will not be without considerable advantage to analyse the structure of the various parts, in order to enable us to compare them with their homologues, in forms that are thought to be more or less congeneric.

[1] In measuring the Scyllaridæ, I have taken the length from the extremity of the larger antennæ to that of the telson.

The body of the animal is dorsally considerably depressed, so that the sharp lateral margins which correspond with the branchial region in *Panulirus*, *Willemœsia* and *Eryon*, are thinned out to an extent equalling that of some of the Brachyura, and the cervical fossa, which in the Macrura is frequently so very conspicuous, and ends in a slight notch, is absent in this species, while the lateral notch is deepened to a very considerable extent, and widely separates the suborbital and hepatic regions from the branchial. The pleon is also much depressed, and the coxal plates on each side are extended outwards rather than downwards, and the entire aspect of the animal suggests that it has, through a series of generations, been compelled to live where it was necessary to extend itself, under a constant heavy pressure, against some resisting body.

The eyes are implanted in orbits that are deeply excavated in the dorsal surface of the cephalon; the angles, more especially the external, are considerably produced, so that the orbit makes about two-thirds of a circle, the margin of which is fringed with a copious blepharis. The infero-anterior margin of the orbit also is excavated in the frontal surface, so that a glimpse of vision might have been obtained beneath, when the eyes were ensconced within the depth of the orbit.

The first pair of antennæ (Pl. VIII. fig. *C*, *b*) possesses much of the character of those of the Brachyura. The three joints of the peduncle are moderately long, and the terminal flagella short, arising from the circumstance that the numerous articuli, more especially in the primary branch, are extremely short and closely compressed together, so that the membranous cilia are gathered together in a closely-arranged mass. At the base of the first joint, on the upper surface, is a small tubercle, behind which the foramen, protected by a bundle of small hairs, opens into the auditory chamber.

The second pair of antennæ (Pl. VIII. fig. *C*, *c*) is of peculiar form, and characteristic of this family. It consists of five joints. The first or coxal joint is closely fused with the ventral portion of the cephalon, and carries on the inferior surface a phymacerite, which is planted so near the oral aperture, that it is covered and protected by the organs attendant on the mouth. The somite that carries this pair of antennæ is visible at the base of the first pair on the upper or dorsal surface in the form of two small plates (Pl. VIII. fig. *C*) dove-tailed into the frontal margin on each side of what in a normal condition would be the rostrum; the anterior margin of the carapace and the upper surface of the first antennal somite appear to be fused, and by the generally depressed character of the animal, are brought into a horizontal position in the same plane. The posterior margin dips beneath the anterior margin of the carapace, and passing laterally, forms the floor of the orbit, whence it continues upwards to the orbital notch, thence outwards, forming the great antero-lateral angle of the carapace, and, being reflexed on itself, returns and unites with the ventral walls of the coxal joint of the second pair of antennæ. The second or basisal joint articulates with the first, with very little movement, and impinges very closely against the external lateral walls of the first

antennal somite. The third joint articulates with the second, at points situated at the internal and external angles, and externally is produced into a thin scale of large size, reaching as far as the lateral angle of the carapace; the anterior and posterior margins are parallel, and the external lateral angles are anteriorly produced to a sharp point, and the posterior rounded off. The fourth joint articulates with the third at points near the middle of the margin of the dorsal and ventral surfaces; it is produced to a tolerably sharp angle or tooth on the inner surface, but none upon the outer. The fifth or distal joint articulates with the fourth by points situated at the inner inferior angle and the upper exterior angle; the joint is flattened and distended to a thin plate or scale that corresponds with the extent of the squamous portion of the third joint; its anterior margin is thickly fringed with hairs, and on the upper surface, near the base, just beyond the articulation with the previous joint, is a slight elevation studded with numerous small imperforate depressions which correspond with prominent points on the inside, that have slightly bulbous and roughened extremities, apparently adapted for the purpose of muscular attachment. On the external surface, in a corresponding position beneath, is a circular depression, the surface of which is covered with thick, short fur, consisting of hairs thickly fringed with long delicate cilia.

The epistoma is reduced to a minimum. The cheiloglossa which articulates with it, is calcareous anteriorly, and dips beneath the mandibles, which meet each other over it.

The mandibles (Pl. VII. fig. 2, *d*) are strongly denticulate at the incisive margin, and carry a rather long, slightly curved uniarticulate synaphipod; the apophysis is long and rather slender, and continues beyond the articulation at the extremity into a strong calcareous process at an obtuse angle, that supplies the place of the usual muscular attachment, near the molar tubercle, and enables the mandibles to open and close.

The metastoma is a single, thick-lobed mass, that closes over and behind the mandibles and first pair of siagnopoda.

The first pair of siagnopoda (Pl. VII. fig. 2, *e*) consists of two thin curved branches, having the extremity rounded and fringed with strong spines that pass into hairs at the upper margin of the outer and the lower margin of the inner. The two branches are sub-equal, and the margins are parallel; at the base of the outer is a small fasciculus of ciliated hairs.

The second pair of siagnopoda (*f*) consists of a single truncated branch, stunted in form, and excavated at the extremity, supported by a large, somewhat fan-shaped mastigobranchial plate; the narrow portion is directed anteriorly, the whole forming an efficient operculum against the exit of the water, which it has the power to confine within the branchial chamber.

The third pair of siagnopoda (*g*) consists of two branches and a mastigobranchial plate. The outer branch is double and longitudinally angular, truncated at the apex, and is connected with the mastigobranchia, being articulated with it; the inner branch

is foliaceous, narrow, with parallel straight sides, terminating in a rounded extremity fringed with spines.

The gnathopoda are short, peculiar, but not abnormal. The first pair has the dactylos broad and spatuliform, fringed with a series of deeply-implanted stiff spines; the propodos is broad, short, and flat, as is the carpos, which has the outer margin long and curved, the inner short, and consequently, in articulating at one extremity with the meros, and at the other with the propodos, induces a sudden and permanent curve; the meros is broad, and longer than either of the other joints, fringed on the inner side with long hairs; ischium short and broad, and fused with the basis, which carries a tolerably long ecphysis, terminating in a multiarticulate lash, fringed with hairs; coxa short, and supporting a broad mastigobranchia, with a narrow rigid neck, on the anterior side of which is a short and rather small podobranchia, while at the membranous pleural articulation two arthrobranchiæ are attached, the anterior being small, not larger than the podobranchia, and the posterior is much larger and longer.

The second pair of gnathopoda has the dactylos long and slender, diagonally flattened, and fringed with spines: the propodos is not longer than the dactylos, rounded on the outer side, and flattened on the side nearest the mouth; the carpos is short, curved, and arched, articulating with the meros on the under side (or that nearest the mouth); the meros is longer than either of the other joints, having the distal extremity produced into a large, smooth lobe that projects beyond the carpos; inner margin flattened, against which the reflexed distal joint presses; upper surface engrailed at the inner margin; outer margin flattened to a thin serrate crest: the ischium is broad and flattened to a thin, smooth crest on the outer margin, thickened on the inner side to a double margin, the upper of which is smooth, the lower evenly denticulated, the intermediate space being hollow and smooth: the basis is short and narrow, attached to if not actually anchylosed with the ischium, which is thickened on the inner side, where the distal angle is produced to a broad obtuse point, while the outer is flattened and shortened to a process that supports a rigid two-jointed ecphysis, the basal joint of which is serrate on the outer surface, and multi-articulate and hairy on the distal: the coxa is broad and flat on the outer surface, and produced to an obtuse tooth or point on the inner anterior angle. It supports a broad, bat-shaped mastigobranchia projected on a slender stalk, to which is attached a podobranchia about half its length; and to the podopleural articulation are attached two, not very large arthrobranchiæ.

The first pair of pereiopoda is acuminate, and but slightly more robust than the succeeding pairs, even in the male. It carries a pointed bat-shaped mastigobranchia, supported on a slender stem, to the base of which is attached a podobranchia about the same length as itself; to the podopleural articulation are attached two arthrobranchiæ, of which the anterior is the smaller, and lies over the posterior. The three succeeding pairs of pereiopoda have the branchial plumes larger than the first, and have

a pleurobranchia springing from a fissure that defines a separation between the somites; the point of attachment is very low, not very much above the podopleural articulation.

The second and succeeding pereiopoda are themselves rather more slender than the first pair, but this is chiefly due to the lower margin of the propodos being hollowed or excavate in all but the first. The third pair in the female carries the foramen of the vulva near the inferior podopleural articulation, in the form of a circular opening on a prominent elevation. The fifth or last pair of pereiopoda in the male carries the foramen of the vas deferens on the antero-inferior angle of the coxa, and is much larger in diameter than that of the vulvar opening in a female of corresponding size. This last pair of pereiopoda has no mastigobranchia or branchial plume, except a pleurobranchia, and this is implanted very near to the podopleural articulation.

The arrangement of the branchiæ may be best seen in the following table:—

Pleurobranchiæ,	.	.	...	...	...	...	1	1	1	1
Arthrobranchiæ,	.	.	...	2	2	2	2	2	2	...
Podobranchiæ,	.	.	...	1	1	1	1	1	1	...
Mastigobranchiæ,	.	.	...	1	1	1	1	1	1	...
				h	i	k	l	m	n	o

This species affords the only specimens of the genus taken elsewhere than along the Pacific coasts of Asia and the Australasian Islands. Hence the similarity that it bears to *Ibaccus incisus* (Péron) is the more remarkable, and, judging by the several figures and descriptions published, the differences are slight, except in the character and number of the dentations that arm the margins of the carapace and antennæ.

Ibaccus brevipes, n. sp. (Pl. IX. fig. 1).

This species resembles *Ibaccus verdi*, and is armed with seventeen small teeth along the lateral margin of the branchial region of the carapace; none or only a fine serrature on the outer margin of the anterior angle of the carapace; three or four along the outer margin of the posterior antennal plate; and six or seven along the distal margin of the anterior antennal plate.

The pleopoda are very small and biramose, the inner ramus supporting a comparatively large stylamblys.

Length, 67 mm. (2·7 inches).

Habitat.—Station 192, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; off the Ki Islands; depth, 140 fathoms; blue mud.

There is but one specimen of this species in the collection, and that a male, which bears all the characteristics of being immature; and had it been taken anywhere near

where *Ibaccus verdi* was obtained, it would without hesitation be pronounced to be an undeveloped male of that species, which in most of its characteristics it much resembles.

It is about two inches and a half in length; and although a male, has seven strong points or teeth on the distal margin of the anterior antennal plate, which in *Ibaccus verdi* is smooth in this sex, and has nine strong dental points in the female, the margin also being more rounded than in the male, which is also the case in *Ibaccus brevipes*, and may be consequent upon its undeveloped state, since the males approach more nearly to the general external characters of the female the younger they are.

The pleopoda (Pl. IX. fig. 1*q*) are apparently in a very immature condition, but they exhibit features that appear not to belong to any other species. They are extremely minute, being indeed quite rudimentary. Upon being examined under a moderate magnifying power, they are seen to have two branches, the inner supporting a small secondary lobe. Each branch, as well as the basal joint, is short, bulbous, free from hairs, and attached at the base by a small pedicle. The branches are shorter than the basal joint, and the inner carries a short, stout stylamblys. In most other details this species resembles *Ibaccus verdi*, except that it is scarcely half as large. The Ki Islands, Arafura Sea, and the Cape Verde Islands, whence the two forms have been obtained, are nearly antipodal to each other, being in corresponding degrees of latitude north and south of the equator.

Ibaccus alticrenatus, n. sp. (Pl. IX. fig. 2).

Antebranchial or cervical notch deep and broad. Lateral margin of the branchial region armed with eight teeth, of which the anterior is very large and the posterior rudimentary; none on the anterior angle of the carapace, which is produced to a point; none on the outer or lateral margin of the posterior plate of the second pair of antennæ, and five or six teeth of equal size, distantly separated from each other, on the distal margin of the anterior plate.

The pleon has the coxal plates converging laterally to a point more acute anteriorly than posteriorly. Length, including antennæ, 87 mm. (3·5 inches).

Habitat.—Station 167, west of New Zealand, June 24, 1874; lat. 39° 32′ S., long. 171° 48′ E.; depth, 150 fathoms; bottom, blue mud; two males, and two females bearing ova.

This species approximates in appearance somewhat to *Thenus orientalis*. It is widest at the anterior margin of the carapace, and gradually narrows to the last somite of the pleon. The antebranchial cleft is very deep and wide, and furnished on the posterior margin with a fringe of rather long hairs. The anterior margin of the carapace is crenated externally to the orbits, which are circular, rather large, open in front, and fringed round the margin with a closely-packed blepharis. The outer and inner angles of the orbit are

produced to a sharp point; the antero-lateral angle of the carapace also terminates in a pointed process, curved upwards and forwards, the posterior margin of which is perfectly smooth. The anterior angle or tooth of the lateral branchial margin is large, and extends to a level with the antero-lateral angle of the carapace. Those posterior to it decrease in size gradually, until they become at the eighth reduced to a rudimentary condition.

The pleon, with the exception of the first somite, which is the narrowest, gradually diminishes in width posteriorly. This is due chiefly to the relative size of the coxal plate which is appended to each somite. Each is produced laterally to a point; in each succeeding somite the postero-lateral margin becomes more prominent, and in the fifth bears a second angle or point. There is a small central tooth on the posterior margin in the median line of the fifth somite, and a crenated edge along the posterior margin of the sixth.

The animal is extensively covered with a thick fur, longest on the second pair of antennæ and along the anterior edge of the several teeth on the lateral margin of the carapace. On the dorsal surface of the carapace, as well as on the pleon, the surface is smooth, the hairs apparently having been rubbed off by friction. Examination of the surface that has been protected shows that the fur partakes more of a pilose than of a hairy nature. The posterior pair of pereiopoda has the dactylos in the male flat, lanceolate, and fringed with small hairs; and it articulates at a right angle with the narrowest axis of the propodos. In the female the dactylos is shorter and more robust than in the male, and carries on the middle of the inner side near the base an elevated oval ridge fringed with a regular series of fine spines corresponding with a stout pollex, about two-thirds of the length of the dactylos, and similarly armed with minute hair-like spines.

The ova were numerous, of a yellow colour, but none of them sufficiently developed to show the character of the brephalos.

Observations.—The general aspect of the animal agrees with that of *Ibaccus incisus*, (Péron) (*Ibaccus peronii*), as given by Leach,[1] which differs slightly from the figure given by Desmarest,[2] and in the description of the armature as given by Milne-Edwards.[3] In Leach's figure there are six teeth represented on the lateral branchial margin of the carapace, posterior to the antebranchial cleft. Desmarest says there are five, and his figure shows that the number includes the anterior branchial angle, but not the anterior angle of the carapace in advance of the branchial cleft. Milne-Edwards agrees with Leach in his description :—"Bords lateraux de la carapace très obliques et armés de septs dents, dont une seule située au devant de la grande, échancrure latérale, et formant l'angle antérieure." We might be inclined to consider our species as being only a variety of *Ibaccus incisus*, but for one or two differences of importance. The chief of these is found in the formation of the second (homologically the third) joint of the second pair of antennæ,

[1] Zool. Miscell., vol. ii. p. 152, pl. cxix.
[2] Consid. des Crust., p. 183, pl. xxi. fig. 2.
[3] Nat. Hist. des Crustacés, t. ii. p. 287.

which widens out into a broad scale whose anterior margin is crenated in gradually lessening degree as it approaches the antero-lateral angle, where it becomes quite smooth. This angle is prolonged forwards to an acute point, in a line with the outer angle of the anterior margin of the carapace, from which the outer margin recedes acutely backwards without any serration. The distal margin of the anterior joint of the same antenna is armed with six teeth, which are widely separated except the two inner, which are closer together. In the female these teeth are longer and sharper than in the male.

The antebranchial or cervical notch is broader than in *Ibaccus incisus*, and the anterior angle of the carapace is narrower and sharper. Our specimens are all about three inches and a half in length, whereas *Ibaccus incisus* is about five inches and a half.

The teeth on the margin of the carapace, inclusive of the anterior angle, are nine, of which the posterior is small, and in one female specimen two others yet smaller are visible. Another feature is that the lateral margin of the fifth somite of the pleon has a posterior as well as an anterior tooth or angle. Milne-Edwards in his description says that the fourth joint (meros) of the "pates-mâchoires externes" (second pair of gnathopoda) is armed with spines on the external margin. In our specimen I should call it serrate, but this is also the condition of the ischium or the third joint on the inferior margin of the inner side, as well as to a greater degree that of the outer margin of the first joint of the basecphysis of the same appendage.

On the dorsal surface in the median line is a slight elevation, scarcely worthy of the designation of a crest, that terminates in a small point or tooth at the posterior margin of the fifth somite. This species appears to be a form nearly allied to the next genus.

Thenus, Leach.

Thenus, Leach, Zool. Miscell.
Scyllarus, Fabr., Suppl., p. 399; Latr., Hist. Nat. des Crust., t. vi. p. 81; Desmarest, Consid. des Crust., p. 182.

Geographical Distribution.—There appears to be only one species of this genus, and that is recorded mostly from the Indian Seas. Sir Walter Elliot found it at Waltair, on the Madras coast, Dr. Percival Wright at the Seychelles, and our small specimen was taken in the Arafura Sea.

There has been no record, so far as I am aware, of any species having been found in a fossil condition nearer than *Thenops scyllariformis*, Bell, from the London clay.

Thenus orientalis, Rumph.

Thenus orientalis, Rumph, Mus., part 2, fig. D; Milne-Edwards, Hist. Nat. des Crust., t. ii. p. 286.
Cancer (*Astacus*) *arctus*, Herbst, t. xi. p. 80, pl. xxx. fig. 1.
Scyllarus orientalis, Fabr., Suppl. p. 399; Latr., Hist. Nat. des Crust., t. vi. p. 181: Encycl., pl. cccxiv.; Desmarest, Consid. des Crust., p. 182, pl. xxxi. fig. 1.

Habitat.—Station 188, Arafura Sea, south of New Guinea; September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; depth, 28 fathoms; bottom, green mud.

The only specimen taken was about 25 mm. (1 inch) in length, and had all the pleopoda in a very feeble and immature condition; just budding. From its young and imperfect character I have not been able to determine the sex to which the animal belongs.

Arctus, Dana.

Scyllarus (*part.*), Fabr., de Haan, et Auct.

This genus was established by Dana to contain several species that differed from the typical *Scyllarus* in having the external antennæ separated widely from each other, in having no ecphysis attached to the second pair of gnathopoda, and in having nineteen branchiæ instead of twenty-one, as exist in *Scyllarus*.

It corresponds with the fifth subgenus of De Haan's genus *Scyllarus*.

Geographical Distribution.—This genus is found sparsely all over the northern hemisphere, in the warm temperate regions. *Arctus ursus* is found on the European shores as far north as the south coast of Devon and Cornwall, and south as far as the Mediterranean. *Arctus pygmæus* and *Arctus immaturus* are from the Canary and Cape Verde Islands, and *Arctus orientalis* is from the Philippine Sea. *Arctus americanus* has been found on the western coast of North America, *Arctus vitiensis* in the seas about the Fiji Islands, and *Arctus sordidus*, and *Arctus haani* in the seas about Japan. There is among the late General Hardwick's drawings, in the possession of the Plymouth Institution, the figure of a species resembling *Arctus pygmæus*, specifically named *ceylonensis*, after the locality where it was found, but I am not aware of its having been described.

Thenops scyllariformis, recorded by Bell[1] as having been found in the London clay, exhibits scarcely a feature that is not common to *Arctus*.

Arctus sordidus, Stimpson (Pl. IX. fig. 3).

Arctus sordidus, Stimpson, Proc. Acad. Nat. Sci. Phil., January 1860; Prodromus, &c., p. 8; Crust. Macr.

Carapace as long as wide at the anterior angles. Median crest bicuspidate; anterior cusp close behind the frontal margin; second much more elevated and larger than the

[1] *Palæont. Soc. Trans.*, pl. vii.

first, having the anterior extremity on a line with the posterior margins of the orbits. A third point is scarcely elevated above the dorsal surface, and corresponds with the posterior margin of the cervical sulcus. The lateral crests traverse the inner wall of the orbits, and are furnished with two small teeth above the eyes and one a little remote posteriorly. The extraorbital crests form the lateral angles, which are produced anteriorly beyond the intero-orbital angles. Two teeth, formed rather by excavations in the margin than by projection of substance, exist along the lateral margin, one immediately posterior to the line of the orbits, the other at some distance posteriorly.

The somites of the pleon form dorsally an obtuse ridge, and the telson is slightly longer than broad, and terminate in a rounded membranous margin.

Length, male 70 mm. (2·8 in.); female 75 mm. (3 in.).

Habitat.—Station 192, off the Ki Islands, Arafura Sea; September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; depth, 140 fathoms; bottom, blue mud.

The surface of the animal is protected by a very thick and short pilose substance, which is more conspicuous on the carapace than on the pleon, and gives it in its perfect condition a smooth velvety appearance, beneath which the integument is ornamented with small and slightly elevated prominences. These are arranged symmetrically on the carapace, while on the pleon they are so displayed that the interstices form symmetrical arborescent figures, the main branch of which traverses each somite from the lateral margin to the dorsal centre, but is not continuous across.

The telson is calcareous halfway down the lateral margins, where it terminates in two sharp points, whereas in the median line the calcareous portion does not extend beyond one-fourth. The membranous division penetrates into a deep excavation in the median line.

The eyes are implanted in large deep circular orbits, surrounded by a strongly-defined ridge.

The first pair of antennæ is slender, but the first joint is more robust than the others, it also widens at the base, on the upper surface of which may be distinctly seen a small semicircular notch or foramen, the entrance to the auditory apparatus.

The second pair of antennæ has the fourth or terminal joint fringed with five prominent cusps (the outer, which is the broadest, is hidden beneath the margin of the second joint), tipped with a small tubercle or point, and one smaller cusp on the inner margin, these are all fringed with ciliated hairs; the third joint is short and narrow, while the second is broad and flat, the diagonal ridge being conspicuous from the absence of the pilose covering rather than from its elevation; the anterior or inner margin has two pointed cusps or teeth, and so has the outer.

The first pair of pereiopoda is short, thick, strong and simple. The second is similar, but longer and less robust. The third differs from the second in having a thin flat

marginal process extending from the carpal articulation to a sharp anteriorly-directed cusp or rudimentary pollex, and so forms with the dactylos an imperfectly sub-chelate appendage. The fourth pair is more slender than the third, and the fifth is slighter and shorter than the fourth, and in the male terminates in a simple styliform dactylos, while in the female it forms a small chela.

The anterior pair of pleopoda (*q*, ♀) consists of two large pear-shaped, unequal, foliaceous plates, on a short basal joint in the female; while in the male (*q*, ♂) the foliaceous plates are reduced in size. The three following pairs (*r*, ♀) in the female consist of one very short basal joint supporting one long, slender, three-jointed branch, the ova carrier, and a small foliaceous plate, all being of the same relative proportions, whereas in the male (*r*, ♂) the foliaceous plate is retained while the long three-jointed ramus is reduced to a rudimentary process, and decreases in size with each succeeding posterior somite.

Observations.—The distinction of this species from *Arctus ursus*[1] of the European seas is scarcely appreciable. Dr. Stimpson records his type specimen from Hong Kong, while those of the present collection were taken in Arafura Sea. Of the specimens brought home by the Challenger one was a male and two were females. The latter were slightly larger than the former, but they otherwise agree in their general aspect, except in the formation of the posterior pair of pereiopoda.

Arctus orientalis, n. sp. (Pl. IX. fig. 4).

Carapace tuberculated along the median dorsal line and branchial regions, and also transversely along the posterior margin of the carapace and somites of the pleon. Anterior margin of the ultimate joint of the second antennæ furnished with five cusps; the antepenultimate with several small teeth on the inner and outer margins.

Length of male, 84 mm. (2·4 in.); female, 59 mm. (3·4 in.). Diameter of ovum, less than 0·3 mm. (0·012 in.).

Habitat.—Station 209, between Bohol and Zebu, January 22, 1878, lat. 10° 14′ N., long. 123° 54′ E.; depth, 95 fathoms; bottom, blue mud; bottom temperature 71° F. Two specimens were got.

Female.—The length of the carapace is equal to the distance between the anterior extra-orbital angles; the median ridge is well defined, but not very prominent; the subrostral point is scarcely determinable; the gastric is more prominent, having, moreover, a small double tuberculation anterior to it; the posterior or post-cervical prominence is equal to the preceding, and continues in a line to the tuberculated ridge corresponding

[1] Dana having given to this genus the name of *Arctus*, I have thought it right to revert to the specific name of *ursus* instead of using that given to it by Herbst, t. xi. p. 83, pl. xxx. fig. 2, omitting the second name of *minor* for convenience.

with the anterior margin of the post-cardiac sulcus; the lateral longitudinal ridges are conspicuous but not very elevated, they are anteriorly smooth and posteriorly tuberculose, and except for the cervical depression, are continuous from the inner canthus of the orbits to the posterior margin of the carapace. The anterior extra-orbital angles are prominent and project considerably beyond the orbits, and the lateral margin of the carapace is divided by two depressions, the anterior corresponding to the cervical sulcus, the other posterior to it. The carapace generally is ornamented by a number of low tubercular prominences most abundant on the branchial, sub-hepatic and gastric regions; on the cardiac border they are regular and closely packed, while on the post-cardiac margins they are smaller and more regularly distributed; along the branchial regions they correspond in a line with the upper and lower margins, and disappear altogether on the lower or inflected surface.

The pleon is also tuberculated, the tubercles running transversely on each somite, from the median ridge to the coxal plates, in two parallel lines, and are generally smaller than the tubercles on the carapace.

The eyes are considerably within the lateral margins of the carapace.

The first joint of the first pair of antennæ reaches to the extremity of the second joint of the second pair, and has its base rather largely developed; the second joint reaches to the extremity of the terminal joint of the second pair, while the third is but little shorter than the preceding joint.

The second pair of antennæ has the fourth or anterior joint adorned with five cusps on the anterior margin, and a smaller on the internal, all of which are thickly fringed with hair. The first joint is narrow; the second has two large, and one or two less conspicuous teeth on the outer margin, and four or five small teeth on the anterior margin; the diagonal ridge is slightly curved and projects as far as, if not slightly beyond, the extremity of the most anterior cusp of the anterior joint; the whole surface being covered with a thick pilose fur. The ventral surface of the pereion is sparsely covered with short fur.

The first pair of pereiopoda is short, robust, and simple, adorned with a row of hairs along the upper and lower margins of the propodos.

The second pair is longer than the first, and has the propodos broad and flat; the upper surface is adorned with a row of hairs, as is also the lower margin; while on the latter the hairs continue along the same margin to the extremity of the basis.

The third pair of pereiopoda has the propodos broader and longer than the second, and is fringed with hairs on the upper and lower margins, as is also the upper margin of the dactylos on the inner and outer sides.

The fourth pair of pereiopoda is slender and longer than the third pair, having the dactylos very long and furred with long hairs on the upper margin.

The fifth or posterior pair is shorter than the fourth, equally slender, and terminates

in a well-formed chelate extremity in the female (*o*, ♀), of which the dactylos is longer than the pollex, and is also fringed with the hair on the upper surface.

The anterior pair of pleopoda is large, oval, and foliaceous. The others consist of a small outer foliaceous plate and a long slender three-jointed branch, which supports and carries the ova during gestation.

The male differs from the female in being about one-fourth smaller. It has the third pair of pereiopoda with the propodos broad as in the female, but not so broad as the second pair, where, as in the female, it is larger; and the fifth pair has the dactylos long, slender, simple, and almost as long as that of the fourth (*o*, ♂).

The anterior pair of pleopoda is slender and foliaceous; the three following pairs are rudimentary, and decrease in size with each succeeding somite.

Arctus tuberculatus, n. sp. (Pl. X. figs. 1, 2).

Dorsal surface of the pleon furnished in the median line with a row of large nodulated tubercles, one corresponding to each of the four central somites, the second and third being very elevated, the latter conspicuously overhanging posteriorly, and laterally thickened.

Length, 50 mm. (2 in.).

Habitat.—Station 190, between New Guinea and Australia, September 12, 1874; lat. 8° 56′ S., long. 136° 5′ E.; depth, 49 fathoms; bottom, green mud.

Carapace quadrate, scarcely longer than broad. Median crest formed by a double line of tubercles, flanked by a longitudinal row on each side, and divided into four sections, the anterior or rostral, the gastric, cardiac, and post-cardiac. The gastric rises higher anteriorly than the rostral, and the cardiac higher than the gastric, from which it is separated by a deep cervical sulcus; gradually declining posteriorly it is separated from the post-cardiac section by another sulcus that traverses the carapace from the post-lateral angle on one side to that on the other. The median crest of the post-cardiac section is not elevated higher than the rostral section. On each side, commencing with the inner canthus of the orbits, a longitudinal ridge formed of strong tubercles extends to the posterior margin, being bisected by the deep cutting of the cervical sulcus a short distance behind the orbits. The outer or branchial region of the carapace is strongly marked with anteriorly directed tubercles, placed in longitudinal rows.

The pleon is marked by a tuberculated ridge that traverses the median line, reaching its highest level at the third somite, where it is produced into a large, tuberculated, laterally-compressed knob that extends anteriorly and posteriorly beyond its base and forms a distinguishing feature of the species. The central ridges on the fourth and fifth somites are of a similar character, but less important; there is no central ridge on the sixth.

The first somite is smooth, being, all but the elevated posterior margin, covered by the margin of the carapace when extended. The second somite is also smooth except for the central dorsal ridge and a deep sulcus traversing it from the boundary of the coxal plate transversely to the median ridge. The other somites correspond, but posteriorly the sulcus decreases and the smoothness is changed for a more tuberculated condition, which on the posterior margin increases to a regularly crenated edge, which is conspicuous in the fourth, fifth, and sixth somites. The lateral margins or coxal plates are tuberculated on the dorsal surfaces, and the posterior edges are slightly crenated. The telson is tolerably smooth and free from tuberculations; the anterior division is calcareous, the posterior is membranous.

The eyes are implanted in circular orbits fringed with small cilia.

The first pair of antennæ is slender and longer than the second.

The second pair of antennæ has the terminal joint fringed with seven prominent cusps, the smallest of which is on the inner margin, the others on the anterior. The penultimate joint is small and narrow, while the next is broad and diagonally produced to a point that projects on the outer side of the terminal joint and extends as far forwards as the extremity of the most anterior cusp. The prominent angle of the second joint is continuous with a strong ridge that extends to the base and separates the joint into two divisions, the outer of which is depressed, and has the margin fringed with four strong cusps.

The first pair of pereiopoda is simple in form, short and robust. The three succeeding pairs are sub-equal and moderately long, while the fifth pair is shorter, more slender, and chelate in the female but simple in the male.

The anterior pair of pleopoda has two branches broadly laminar in the female, but long and narrow in the male. The second pair has one ramus, long, slender, and three-jointed, the other short and foliaceous in the female, gradually decreasing in size in each succeeding pair of appendages. In the male these same organs are little more than rudimentary.

Arctus immaturus, n. sp. (Pl. X. fig. 3).

Carapace generally smooth, but showing slight indications of a central ridge with a gastric projection. The cervical sulcus is obscure except where it deeply divides the lateral and branchial ridges on either side. The lateral ridges are broken into a row of narrow tubercles extending to the posterior margin of the carapace. A few imperfectly-developed tubercles are faintly visible under a lens on the genital and cardiac regions.

The pleon is smooth, with a slight central prominence, but without any arborescent configuration of the dorsal surface.

The eyes are implanted in circular orbits within the lateral margin, which is slightly serrate from the anterior to near the posterior angle of the carapace.

The first pair of antennæ has the first joint short, broad and conical, the second and third slender, the terminal joint reaching beyond the extremity of the second pair.

The second pair of antennæ have five cusps on the anterior margin and two on the inner, and is nearly free from cilia. The second or first free joint is armed on the outer margin with three points or teeth and three on the anterior margin, while the longitudinally-oblique ridge is slightly dentate.

The first pair of pereiopoda is larger than the others, and the posterior has a large sharp, curved tooth (fig. 3″) projecting backwards from the posterior angle of the coxal ridge of the podal socket of the ventral plate.

The three anterior somites of the pleon are without pleopoda, those of the second and third being either accidentally absent, or not yet developed. Those of the fourth and fifth somites consist of two long sub-foliaceous branches on a tolerably long stalk. The inner ramus carries a single stylamblys.

Length, 19 mm. (0·75 in.).

Habitat.—The specimen from which this description is taken was dredged off Cape Verde, but neither station nor depth are recorded.

Observations.—Two other specimens were taken off Gomera, one of the Canary Islands, in 75 fathoms of water, associated with *Arctus pygmæus*, with which they have several points in common, that suggest from their association that they might be the males of that small species. They agree in the general form of the second pair of antennæ, the absence of hairs being attributable to sexual variation or to having been worn away by friction and use. Both have minute specks of pigment, more especially on the plates of the second pair of antennæ, but they are considerably more conspicuous on *Arctus pygmæus* than on *Arctus immaturus*. The absence of dorsal ornamentation might also be attributed to sexual difference, but I am not aware of such variation to any great degree in the genus, though in *Ibaccus* the separation is quite as apparent and important.

The reason why I came to the opinion that *Arctus immaturus* is the young of some other form rather than the male of *Arctus pygmæus*, with which it almost corresponds in size, being but a little smaller, depends upon the structure and form of the pleopoda. In *Arctus pygmæus* these appendages agree in structure with those of the adult females of other known species; but in *Arctus immaturus* they agree more with the pleopoda of the males of other types than with those of any species of the genera.

The two sub-foliaceous plates, thickly fringed with long ciliated hairs, the inner of which carries a stylamblys, vary in the three specimens, and in one, apparently the most mature, it is half the length of the branch to which it is attached, and the extremity is covered with small cincinnuli, perhaps the rudimentary condition of hairs which in the females become the important points for the attachment of the ova.

Arctus pygmæus, n. sp. (Pl. X. fig. 4).

Female tuberculated on the cardiac region. Upper lateral margin of the branchial region marked with a row of tubercles. Somites of the pleon transversely furrowed, with anterior and posterior margins ornately scalloped.

Length, 22 mm. (0·875 in.).

Habitat.—Station VIIp, off Gomera, one of the Canary Islands, February 10, 1873; lat. 28° 35′ N., long. 16° 5′ W.; depth 78 fathoms; bottom, volcanic sand.

Carapace longer than the width between the anterior extra-orbital angles. Sub-rostral point small; gastric and epigastric slightly elevated; the latter is continuous with a series of flattened tubercles that form the central ridge, broken only by the imperfectly defined cervical sulcus. The lateral ridges are strongly marked and elevated, commencing at the inner canthus of the orbit, and continuing unbroken to the cervical sulcus, posterior to which the ridge is continued in the form of a series of double tubercles to the latero-posterior margin of the carapace. The anterior extra-orbital angles are prominent, but in close contact with the wall of the orbit; the lateral margin shows no evidence of the cervical depression. The carapace is adorned by a number of flattened tubercles chiefly aggregated between the branchial and cardiac regions. On the former region they exist only as a row along the inferior margin, while on the cardiac border they traverse the width of the dorsal surface as two double rows separated by a narrow post-cardiac sulcus.

The pleon is smooth, with scarcely any median dorsal elevation, on each side of which an arborescent line of depression traverses the surface from the coxal margin to the central ridge, dividing the somite into two unequal portions, and terminating on the anterior margin near the centre, leaving between the two extremities a longitudinal ornamentation of flattened semicircular plates.

The eyes are round and near the lateral margins of the carapace.

The first pair of antennæ has the first joint tolerably robust, the others slender.

The second pair of antennæ has five cusps on the anterior and two small ones on the inner margins, copiously fringed with plumose hairs. On the inferior surface of the externo-posterior margin is a row of small cell-like organs. The second joint has the anterior margin dentate and two stronger teeth on the outer margin; the oblique ridge is strongly prominent, but does not extend so far as the anterior margin of the terminal joint.

The first pair of pereiopoda is robust; the three succeeding are sub-equal and cylindrical, without any enlargement of the propodos; the fifth pair is unfortunately broken from the basal joint in our unique specimen.

The first pair of pleopoda is, as in larger adult forms, foliaceous, and the succeeding pairs have one branch small and leaf-like, and the other rigid and styliform.

Observations.—This specimen carries a large number of ova containing embryos that are far advanced in development, a circumstance that has enabled me, after much trouble and care, to determine the form of the brephalos.

The ovum is about 0·3 mm. (0·012 in.) in diameter, and is perfectly round. By the aid of liquor potassæ I was able to make out the form of the eyes, since they were projected on long stalks. The outer or second pair of antennæ is small and cylindrical, but the first or inner pair I could not determine, nor the exact form of the carapace, and I am therefore doubtful whether it only covers and protects the cephalon as in the brephalos of *Palinurus*, or overlies the pereion also, as figured by De Haan in his species of *Phyllosoma guerini*, which has all the appearance of being a more advanced stage of a young *Scyllarus* or *Ibaccus*.

Three pairs of pereiopoda are well advanced, and carry a basecphysis or branch springing from the extremity of the second or basisal joint, which is also well developed in the two anterior pairs, but represented only by a small bud-like process in the third.

The pleon is short and rudimentary. The entire brephalos, when outstretched at the period of extraction from the egg, was about 0·5 mm. (0·02 in.) in length, measuring from the frontal margin between the eyes to the telson, and resembles the *Phyllosoma* of *Palinurus* in its general appearance.

This species was taken on the 10th of February 1873, in 78 fathoms of water, with two smaller specimens that I am inclined to consider as immature forms of another species, the reasons for which are given in the description of *Arctus immaturus*.

The temperature of the bottom water is not recorded, no temperature sounding having been taken at this station.

Family Palinuridæ.

Carapace longitudinally sub-cylindrical, ophthalmopoda having orbits only partially excavated in the cephalon, second pair of antennæ terminating in a long rigid multi-articulate flagellum.

This family forms the tribe of "Langoustiens," which contains but one genus *Palinurus*, and this Milne-Edwards has in his Histoire des Crustacés divided into two subgenera, "Langoustes ordinaires," of which *Palinurus vulgaris* is the type, and "Langoustes longicornes." This latter he again subdivides into—(1) those species which have the pleon transversely furrowed, of which *Palinurus guttatus* is the type; and (2) those in which the pleon is not furrowed, of which *Palinurus fasciatus* is the type.

More recently Dr. Camil Heller, in his volume on the Crûstacea which were taken during the cruise of the frigate "Novara," has, like Milne-Edwards, arranged the species under one genus, which he places in two divisions, as follows—

I. Those corresponding to the "Langoustes ordinaires" of Milne-Edwards, including the subgenus *Palinurus* of Gray. This he again subdivides into—

A. Those which have the rostrum dilated, bipartite, having the processes flat, with the anterior margin spinulose, of which *Palinurus trigonus*, De Haan, (*Linuparis trigonus*, Gray) is the type.

B. Those which have the rostrum simple, acute, and spiniform. This division is again subdivided into—

a. Those which have the first pair of pereiopoda longer than the succeeding pairs—*Palinurus longimanus*, Edw.

b. Those which have the first pair of pereiopoda equal to or shorter than the succeeding pairs—

α. Those which have the somites of the pleon with a transverse furrow. This is again divided into—

a Those which have the lateral frontal horns unarmed above and denticulated below—*Palinurus vulgaris*.

b Those which have the lateral frontal horns unarmed above and below—*Palinurus lalandii*, Lam.; *Palinurus frontalis*, Edw.

β. Those that have the somites of the pleon not transversely furrowed—*Palinurus hügelii*, Heller.

II. Those which correspond with the "Langoustes longicornes" of Milne-Edwards and the subgenus *Panulirus* of Gray. These he again divides into—

A. Those that have no transverse furrow on the pleon, the species of which are *Palinurus fasciatus*, Fabr.; *Palinurus ornatus*, Bosc; *Palinurus sulcatus*, Lam.

B. Those which have a transverse furrow.

a. The first antennal somite armed with two teeth—*Palinurus guttatus*, Latr.; *Palinurus japonicus*, De Haan.

B. The first antennal somite armed with four teeth.

a. Four conical teeth remote.

a Teeth tolerably large, equidistant, and forming a quadrangle.

* Carapace spinose all over—*Palinurus spinosus*, Edw.; *Palinurus americanus*, Edw.

** Carapace spinose anteriorly, tuberculated posteriorly — *Palinurus interruptus*, Randal.

b Teeth minute, scarcely approximate on the median line, anterior and posterior much more distant—*Palinurus argus*, Latr.

β. Four conical teeth approximated and connected at the base—*Palinurus ehrenbergi*, Heller; *Palinurus penicillatus*, Olivier.

C. First antennal somite armed with eight teeth—*Palinurus dasypus*, Fabr.; *Palinurus burgeri*, De Haan.

In the classification of the several genera which belong to this family the three authors, Edwards, Gray, and Heller have made the two great divisions dependent chiefly upon the one having a central rostrum to the frontal margin of the carapace, and the flagella of the first pair of antennæ short, while in the second there is no central rostrum and the flagella are long.

However, there appears to me to be a great natural distinction between the form known as *Palinurus lalandii*, Lam., in which the frontal rostrum is so far advanced and depressed as to unite it with the upper surface of the somite of the second pair of antennæ, thus enclosing the ophthalmic somite within an orbital chamber, instead of leaving it exposed as in *Palinurus vulgaris*, in which the rostrum is reduced to a short pointed process. This also appears to me to be the case in Heller's species of *Palinurus hügelii*, but since Heller has not mentioned it in his description, nor shown it in his figure, I am precluded from asserting this with confidence.

It appears therefore that *Palinurus lalandii* should form a separate genus (*Palinostus*) gradually leading to *Synaxes*, and so on to the family of Astacidæ, according to the arrangement here followed and indicated on p. 56.

Panulirus, Gray.

This name was given by Dr. Gray to that division of the genus which Professor Milne-Edwards designated "Langoustes longicornes." It consists of those species in which there is no central rostriform tooth, which have the ophthalmic somite exposed and

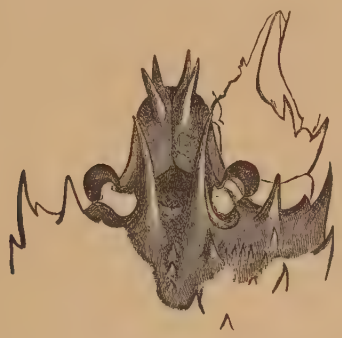

FIG. 5.—Dorsal view of *Panulirus*.

FIG. 6.—Lateral view of *Panulirus*.

membranous, the first antennal somite produced considerably in advance of the frontal margin, which is generally armed with strong teeth in the adult (as shown in the accompanying woodcuts), and in which the terminal filaments of the first pair of antennæ are long and slender. This genus may conveniently be divided into :—

Those species that have no transverse groove on the pleon—

Panulirus fasciatus, Fabr.
,, *ornatus*, Bosc.
,, *sulcatus*, Lam.

Those that have a transverse groove on the pleon—

Panulirus guttatus, Latr.
,, *japonicus*, De Haan.
,, *spinosus*, M.-Edwards.
,, *americanus*, M.-Edwards.
,, *interruptus*, Randal.
,, *argus*, Lat.
,, *ehrenbergii*, Heller.
,, *penicillatus*, Olivier.
,, *dasypus*, Lat.
,, *burgeri*, De Haan.

Geographical Distribution.—There are a large number of species in this genus, but they are mostly confined to the Indian and Pacific Oceans, ranging from the Mauritius,

where *Panulirus ornatus* exists, as the most southern and western station, to the shores of India and Japan, where *Panulirus japonicus*, *Panulirus burgeri*, and *Panulirus fasciatus* are found.

Panulirus guttatus (Latreille).

Palinurus guttatus Latr., Ann. du Mus., iii. p. 393.
" " Milne-Edwards, Hist. des Crust., t. ii. p. 297, pl. xxviii. fig. 1.

"Antennular somite armed with two very large conical teeth sometimes preceded by two rudimentary spines. Carapace very spinous; two spines upon the median line of the gastric region, near the base of the rostral horns, and on each side of these last, upon the anterior border of the carapace, are two teeth nearly as large as they. Anterior border of the epistoma is armed with three subequal conical teeth, separated by a series of small teeth. Peduncle of the outer pair of antennæ very spinous below, second pair of pereiopoda a little longer than the others. Pleon smooth and presenting near the middle of each somite a transverse piliferous groove, which is not interrupted upon the median line in the three first somites. The lateral horns of the pleon are produced to a single tooth. The colour of the animal is green with numerous circular yellow spots; penultimate joints of the pereiopoda longitudinally striped with green and yellow.

"Length 7 to 8 inches.

"*Habitat.*—Antilles."—Milne-Edwards, *loc. cit.*

Panulirus guttatus, var. (Pl. XA.)

Antennular somite armed with two sharp conical teeth on the anterior border. Dorsal surface smooth; three small sharp teeth on the median line on the gastric region, and on each side two large supra-orbital teeth, (called rostral horns by Milne-Edwards) sharply pointed and directed forward above the base of the ophthalmopoda; behind these are two other important but not very large sharp teeth, and a row of smaller and gradually decreasing teeth, sharp at the point but large at the base, is continued to the posterior marginal suture of the carapace; these are more conspicuously determinable in the female than in the male. There is a large and well-developed tooth within the anterior margin, corresponding to the first antennal tooth in the typical structure, and another corresponding with the outer antennal tooth of the same ideal type; these two teeth are probably those that Milne-Edwards describes as being the two large teeth on the anterior border. The frontal margin of what Professor Milne-Edwards calls the epistoma, but which appears to be demonstrable as the first or coxal joint of the second pair of antennæ, is armed with three subequal conical teeth, separated by a series of four small teeth on each side of the central one. Peduncle of the outer antennæ armed with short spine-like teeth, more numerous on the upper surface than on the lower, which is also smoother. Second pair of pereiopoda, a little longer than the others

Pleon smooth and presenting near the middle of each somite a transverse piliferous groove. That on the first somite corresponds with the posterior margin of the carapace; the hirsute line is anteriorly directed, and continuous from side to side. That on the second somite has the hairs directed posteriorly and is indented in the median line. The third is also indented in the male and interrupted in the female. The fourth and fifth are interrupted in both male and female, and the sixth is continuous and wavy. The lateral margin of the somites of the pleon is produced to a large, sharp, posteriorly curved tooth and a posterior rudimentary one.

The colour of the specimen, so far as I can judge from those preserved in spirits, is purple in the male and brown in the female, with numerous yellow spots on the pleon. All the joints of the pereiopoda, except the dactylos, are longitudinally striped with yellow lines.

Length of male, 190 mm. (7·5 in.).

Length of female, 150 mm. (6 in.).

Habitat.—St. Paul's Rocks, Atlantic Ocean, August 1873.

Specimens in the British Museum are recorded from West Indies, the Isle of France, and a variety from New Holland.

In the diagnosis of our variety I have compared it in detail with that of Milne-Edwards for the purpose of convenient reference.

The ophthalmic somite is rudimentary or only represented by membranous tissue, at the lateral extremities of which the ophthalmopoda are situated.

The first antennal somite is projected from the lower margin of the ophthalmic horizontally forwards, where it is armed with two anteriorly directed sharp-pointed teeth, whence the somite dips suddenly downwards and supports the first pair of antennæ. The second antennal somite cannot be differentiated from the carapace which overrides it.

The carapace is armed with two large supra-orbital teeth, one over each eye, sharply curved and anteriorly directed, also on the frontal margin a sharp and well-developed first and second antennal tooth. Posterior to and at the base of the supra-orbital tooth is a second well-developed tooth of similar character, but smaller, and between them are three small teeth longitudinally situated in the median line; over the surface of the carapace large-based and sharp-pointed teeth are sparsely scattered, and between them the surface is covered with large granulations, the anterior margin of each granule being furnished with a few anteriorly directed small hairs, which are more conspicuous on the female than on the male. The cervical groove is well-defined in the male but less so in the female.

The pleon is smooth and has the lateral margins produced to long teeth, one corresponding with each somite, added to which is a smaller tooth situated near the articulation with the succeeding somite. The sixth somite has the posterior margin dorsally fringed with numerous small teeth.

The telson is quadrate, with the base calcareous, longer at the sides than in the median line, posterior margins fringed with small teeth; posterior division membranous.

The ophthalmopoda are short and thick and united to the membranous somite by a narrow articulation.

The first pair of antennæ is smooth, slender and cylindrical. The first joint is the longest, the second the shortest, and the third is but little longer than the second; the terminal flagella are nearly as long as the peduncle, and together they equal the carapace in length. The entrance to the acoustic apparatus is by a diagonal fissure, protected by small hairs, on the upper surface at the base of the first joint.

The second pair of antennæ is a little longer than the entire animal. The first joint of the peduncle is fused with the metope, the second joint has only one sharp tooth below and two above, one being on each side of the posterior articulation; on the inner side an efficient stridulating organ exists (fig. *c*). The third joint is armed with several sharp teeth on the upper surface, but none that are important on the lower. This is also true with regard to the fourth joint. The flagellum is long, rigid, slender and tapering, it is armed with spines or sharp teeth situated in longitudinal and transverse rows, those on the upper surface are both larger and closer together than those on the lower.

The oral appendages correspond with those of the genus generally.

The pereiopoda are simple in structure and uniform in character; the first pair is the most robust, the second is the longest, the others gradually decrease in length and thickness. The dactylos of the anterior pairs is furnished with a thick brush of hairs that is continued in a couple of rows of fasciculi of the same character on the under surface of the distal extremity of the propodos.

In the female the posterior pair is peculiarly chelate. The propodos has a pollciform process developed at the lower distal angle, which antagonises a similar process developed at the base of the lower surface of the dactylos; the two form a small but efficient chela, while the dactylos proper is produced as in the preceding, from which it differs only in being smaller in a proportion corresponding with those anterior to it.

In the male the anterior three pairs have the upper distal extremity of the meros unarmed, and the last two furnished with a strong tooth.

In the female this tooth exists on all the pereiopoda. At the base of the first or coxal joint, close to the articulation with the plastron, is the foramen of the oviduct, which is very minute.

In the male the posterior pair of pereiopoda possesses in the same situation a large opening that is increased in size by the nearer portion of the joint being enlarged into a process projecting on the inner side.

In the male there are two small calcified tubercles on each side of the median line at the posterior margin of the pereion, which are absent in the female.

There are no pleopoda attached to the first somite, while each of the four following

carries a broad foliaceous pair, which is single in the male, and double-branched in the female, in which the inner branch is triarticulate, the first joint stout and cylindrical, the second short and foliaceous on the outer side, while the third is long, slender, and terminates in a few hairs. It is this inner branch that carries attached to it the numerous bundles of minute ova which in this one animal cannot number less than 60,000.

The posterior pair of pleopoda form the outer plates of the caudal fan and are broad and equally foliaceous.

Our specimens consist of one male and three females, only one of which was carrying ova. On the females, particularly on one, there is a large mass of black pigment uniformly deposited on each side on the ventral surface of the posterior somite of the pereion, the object of which I do not quite understand, but assume that it may be of similar nature to the white patches that are to be found attached to the same parts in the female of *Astacus* at the conclusion of the rutting season.

Panulirus angulatus, n. sp. (Pl. XI. figs. 2, 3, 4).

Lateral walls of the carapace perpendicular, forming right angles with the dorsal surface; the angular ridges are prominent and very strongly serrate with three or four large teeth, the first being the largest, and anterior to the cervical suture, posteriorly to which they are of less importance, gradually lessening as they reach the posterior margin; on the gastric region are two rows of these small teeth; in the central line behind the cervical suture, is an elevated boss or lobe surmounted by three strong teeth, the posterior, which is broken in our specimen, being the largest; behind these in the same line is another boss or lobe with two teeth. Each somite of the pleon in the median line supports two or three teeth on an elevated ridge, of which the central of those on the second and third somites are the most conspicuous and prominent.

The specimen is undoubtedly a young animal, being only 36 mm. in length (1·5 inches) exclusive of the antennæ.

Habitat.—Station 219, March 10, 1875; lat. 1° 54′ S., long. 146° 39′ 40″ E.; Eastern Pacific, north of New Guinea; depth, 150 fathoms; bottom, coral mud; associated with *Sicyonia lævis*.

The carapace between the armature anteriorly to the cervical suture is smooth, but granulated rather coarsely posterior to it; the condition on the lateral walls is similar, but the granulations posteriorly to the cervical suture run in parallel lines, radiating from the upper anterior angle just behind the cervical suture. The teeth along the lateral angle increase in size as they advance towards the anterior margin to the upper and inner canthus of the orbit, where the terminal tooth overhangs the eye, forming the upper surface of an imperfect orbit. There are no teeth between the supra-orbital teeth on the frontal margin, and none on the antennal somites.

The ophthalmopoda are short and stout, placed at the extremity of slender attachments which are not enclosed in a calcareous somite, but continue exposed in the median line.

The first pair of antennæ has the first joint long, the second short, and the third about half the length of the first; the flagella are subequal in length, the inner being rather the longer and more slender, while the outer, slender towards the extremity, becomes bulbous towards the base.

The second antennæ are very long and rigid organs, the peduncular portion being especially rigid, and the articulation between the third and fourth joints being oblique by two-thirds the length of the fourth joint; the first and second joints are fused together and support a phymacerite that is covered by the extremity of the second pair of gnathopoda.

The mandible carries a small slender two-jointed synaphipod, the basal joint of which is long, the distal one short and pointed.

The first pair of gnathopoda is short, and carries a basecphysis that reaches considerably beyond the extremity of the dactylos.

The second pair of gnathopoda is long, slender, and serrate on the inner and lower margins, and carries a basecphysis, the basal joint of which reaches to the extremity of the ischium, and the terminal flagellum to the extremity of the carpos.

The pereiopoda are in our unique specimen all lost, having been broken off at the basi-coxal articulation, excepting the last pair, which is long and slender, the meros being strong and distally armed with a strong tooth on the inner angle; the carpos is long and continuous with the propodos, which is nearly three times as long and terminates in a straight and pointed dactylos.

On the under or ventral surface, the posterior somite of the pereion is armed with a sharp tooth in the median line. The first somite of the pleon is transversely armed with four teeth; the second, third, fourth, and fifth, with two each, all on their posterior margins; the sixth has two on the anterior margin, six (three on each side, of the median line) near the centre, and four on the posterior margin.

The pleopoda are small, but not more so than usual in the male, as is this specimen; although the animal is very small, it appears to have arrived at its mature form.

Panulirus penicillatus (Olivier) (Pl. XII. fig. 2).

Astacus penicillatus, Olivier, Encycl., t. vi. p. 343.
Palinurus penicillatus, Milne-Edwards, Hist. des Crust., t. ii. p. 299; Olivier, Encycl., t. viii. p. 174.

Habitat.—Our specimen was purchased in the market at Papiete, Tahiti. Specimens in the British Museum are recorded from the Fiji Islands and the New Hebrides, where the native name is "Trichivaing." H. Milne-Edwards gives the Indian Ocean for its locality; and Professor A. Milne-Edwards says that it has been taken at the Mauritius.

There can be little doubt, I think, that this specimen, which is a male about nine inches in length, belongs to this species. It possesses the chief character given by Milne-Edwards. "Anneau antennulaire armé de quatre dents coniques très grosses, divergentes et réunies à leur base en faisceau." It also corresponds much in colour, for although our specimen has been several years in spirits, it is still beautifully marked with purple, blue, green, brown, and yellow, as in Lamark's description of *Palinurus versicolor*, which Milne-Edwards considers to be identical, and the legs are marked with longitudinal stripes.

Though the geographical distribution of this species appears to be very extensive, it seems to be chiefly limited to the southern and warmer seas. In the British Museum there is a specimen supposed to be from the Red Sea, but this perhaps may be *Palinurus ehrenbergi*, Heller, to which it bears some resemblance.

The branchial arrangement of this species corresponds more nearly with that of the European form *Palinurus vulgaris* than with that of *Palinostus* (*Palinurus*) *lalandii*, a circumstance showing that small branchial variation has generic value.

The mastigobranchiæ are without the peculiar curve or notch that exists in those of *Palinostus* (*Palinurus*) *lalandii*, except in the case of the third siagnopod, which is longitudinally rigid and bent or notched at the extremity, folds backwards through its whole length and enfolds the podobranchial plume, as may be seen in Pl. XII. fig. 2.

The arrangement of the branchiæ is shown in the following table :—

Pleurobranchiæ,	...	...	...	1	1	1	1		
Arthrobranchiæ,	1	1	2	2	2	2	...		
Podobranchiæ,	1	1	1	1	1	1	...		
Mastigobranchiæ,	1	1	1	1	1	1	...		
	h	i	k	l	m	n	o		

Observations.—It is in this species that the interesting transformation of the ophthalmopod into an appendage resembling an antenna was observed by Prof. A. Milne-Edwards and described by him.[1] He says, "guided by theoretical considerations, zoologists regard the movable eye-stalks, the appendages of the mouth, and the legs of Crustacea, as being analogous organs (*organes analogues*), resulting from secondary modifications, impressed on different members of a series of appendages of the same order which represent each other mutually in the organism as a whole; but hitherto these ideas were not supported by any fact which could be brought as evidence of the possibility of the production of these various physiological instruments from one and the same anatomical element.

"One such teratological case which I have observed in a Langoustes, *Palinurus penicillatus* (Olivier), demonstrates the truthfulness of these ideas introduced into science by Savigny, and developed by M. H. Milne-Edwards."

[1] *Comptes rendus*, t. lix. p. 710.

"On the right side, the appendages of this large Crustacean present nothing abnormal; the protocephalic member or appendage of the first ring of the head usually forms an ocular peduncle; the deutocephalic member consists of an antennule, and the appendage of the third somite is the large or external antenna. On the left side, the second and third appendages are symmetrical; but the ophthalmic somite carries instead of an eye, a long multiarticulate filament, resembling the terminal flagellum of an antenna. The ophthalmopod has been preserved in its ordinary character at the base: even at its extremity a rudimentary cornea exists, from the centre of which the flagellum to which I allude originates and extends to the length of about four centimetres. It is multiarticulate and furnished with hairs upon the superior and terminal portion, like the inferior flagellum of the antennule.

"I know of no other example of a transformation of this kind among the Crustacea or other Articulata. A number of monstrosities occur in the formation of dactyli or phenomena of the same kind; but I have never seen an appendage present its normal form on one side of the body and revert on the opposite side to the characters of another organ. The interesting point to which I desire to draw the attention of zoologists is not only the novelty of the occurrence, but also because it shows that in the animal kingdom a kind of phenomena similar to those that we see in vegetables often exists.

"When a leaf is transformed, it may be into a bract, a sepal, or a petal, &c., or when a petal or a stamen may mutually revert to a leaf-like condition, these transformations realise in the animal as well as in the vegetable kingdom, the theoretic view relative to the fundamental origin of parts susceptible to a reversion of different characters, and on this subject I may recall the fact that among certain Crustacea, the dactylos of the first pair of pereiopoda becomes normally multiarticulate and antenniform. The genus *Mastigopus* of M. Stimpson offers us a remarkable example."

Palinurus, Fabricius.

The genus, as restricted by Dr. Gray and Dana, is here confined to those species which Milne-Edwards ranges under the head of "Langoustes ordinaires," in which the most apparent characteristics are the presence of a small central rostriform tooth or tubercle that overhangs but does not cover or enclose the ophthalmic somite, which is generally calcareous, the form of the somite of the first pair of antennæ which is anteriorly produced and laterally compressed in front (as shown in the accompanying woodcuts taken from the type of the genus), and the shortness of the flagella belonging to the first pair of antennæ.

Geographical Distribution.—The genus as restricted in this description appears to be confined to the northern hemisphere, *Palinurus vulgaris*, which is the type, is found on

the European shores including those of the Mediterranean. *Palinurus longimanus* comes from the West Indies. *Palinurus trigonus*, v. Siebold, from Japan, belongs to Gray's genus *Linuparis*, no species of which is in the Challenger collection.

Fig. 7.—Dorsal view of *Palinurus vulgaris*.

Fig. 8.—Lateral view of same.

The nearest approach in geological time is the little *Palinurina pygmæa* described by Münster, from specimens found in the upper White Jura of Bavaria, and *Palinurus longipes*, Münster, from the Lias of England and the lithographic stone of Solenhofen.

Palinostus,[1] n. gen.

This genus consists of those species that have the rostrum anteriorly produced so as to reach beyond the ophthalmic somite, and by its connection with the somite that carries the second pair of antennæ forming a channel for the protection of the ophthalmic

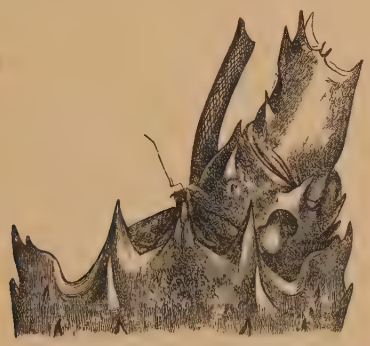

Fig. 9.—Dorsal view of *Palinostus lalandii*.

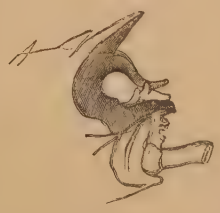

Fig. 10.—Lateral view of same.

somite. The somite that carries the first pair of antennæ is not produced beyond the extremity of the rostrum (see accompanying woodcuts, figs. 9, 10). First pair of antennæ furnished with two short flagella. *Palinostus lalandii* (Lamarck), *Palinostus frontalis*, (Milne-Edwards), *Palinostus hügelii* (Heller).

[1] Παλινοστος, *returning or going back*, from a tendency to return to a form of Macrura in which the rostrum is common; chosen from a desire to secure a name that approximates in sound to that which it previously possessed.

Geographical Distribution.—This restricted genus as far as known belongs to the southern hemisphere. *Palinostus lalandii* ranges from the Island of Tristan da Cunha to the Cape of Good Hope; *Palinostus frontalis* is found on the coast of Chili, and *Palinostus hügelii* was taken in the Indian Ocean.

Palinostus lalandii (Lamarck) (Pl. XI. fig. 1; Pl. XII. fig. 1).

Palinurus lalandii, Lamarck, MS., in Museum, Jardin des Plantes.
" " Milne-Edwards, Hist. des Crust., t. ii. p. 293.
" " on Pl. XI. fig. 1; Pl. XII. fig. 1.

Rostrum depressed and rapidly narrowing anteriorly to the apex, which has a tendency to curve upwards; just within the apex are planted two vertical processes (fig. 10, p. 85) that securely grasp the rostrum on each side. These calcified processes originate in the anterior wall of the ophthalmic somite, which proceeds in a direct line beyond the vertical processes, and terminate in an obtuse point on each side of the central line, corresponding in length to the rostrum.

In *Palinurus* and *Panulirus*, the first antennal somite is largely developed and forces the second pair of antennæ widely apart; in *Palinostus lalandii* it is reduced in size and forced down below the second pair of antennæ, which meet and articulate above it. The first or coxal joint, in all species of this family, is closely impacted and anchylosed with the anterior wall or metope of the cephalon, and meets its fellow in the median line beneath the rostrum; it sends forth a process that articulates with a similar one projecting from the lower and outer angle of the second joint; the upper and inner angle of the same joint articulates with a process which projects anteriorly from the first antennal somite, below the rostral points. This articulation is wanting in both *Palinurus* and *Panulirus*, and instead of it, the process of the antenna projects above and carries a membranous fold over the antero-lateral walls of the largely developed first antennal somite, under which lies the stridulating organ. This organ is absent in *Palinostus*.

The first pair of gnathopoda has only six joints, the meros and ischium being probably fused together into one which is short, thick, and scarcely longer than broad. The carpos is short, triangular, and articulates laterally and bends suddenly; the propodos is broad and the dactylos short and wide; the basal joint of the basecphysis is nearly as long as the mero-ischial joint, and terminates in a long slender flagellum.

The second pair of gnathopoda consists of seven joints, the meros and ischium being free and articulated near the centre; the carpos articulates at the extremity; the propodos is narrow, increasing slightly in length towards the distal extremity, which is excavated to receive the long, narrow, and obtuse dactylos. The whole appendage is fringed with long hairs on the inner and distal surfaces.

The basecphysis is short, the extremity of the flagellum reaching to half the length of the meros. The mastigobranchia is broad, bifid, and supports a slender full-plumed podobranchia.

The branchiæ generally consist of large and well-developed plumes, arranged as in the annexed table :—

Pleurobranchiæ,	...	...	...	1	1	1	1
Arthrobranchiæ,	...	2	2	2	2	2	...
Podobranchiæ,	1	1	1	1	1	1	...
Mastigobranchiæ,	1	1	1	1	1	1	...
	h	i	k	l	m	n	o

The mastigobranchiæ have a peculiar notch or bend in the outer or posterior margin ; in that of the second gnathopoda it is increased to a deep cleft. This curve or excavation may be only a specific feature, but inasmuch as it does not exist in *Palinurus vulgaris*, it may be of generic value, a point that can only be determined when other species are examined.

Habitat.—Station 135c, October 17, 1873 ; lat. 37° 25′ 30″ S., long. 12° 28′ 30″ W.; off Nightingale Island, Tristan da Cunha ; depth, 100 to 150 fathoms ; bottom, hard ground, shells, gravel. One specimen.

Length 248 mm. (10 in.).

This species has been described under the name of *Palinurus lalandii* by Professor Milne-Edwards, from a specimen of Lamarck's preserved in the museum, but, as far as I am aware, it has never been figured.

Two small specimens of what I believe to be the young of this species were taken from the screw of the Challenger the day after she left the Cape of Good Hope. The armature and ornamentation correspond with those of the adult. The specimen is about 25 mm. in length, and appears to be perfectly formed in all except its sexual characters. No foramen or opening could be detected on the coxa of either the third or fifth pair of pereiopoda, whereas in the adult it is very conspicuous, more especially in the male, where it is elevated on a prominent tubercle implanted close to the pleural articulation.

This small animal is one of considerable interest, inasmuch as it shows that *Palinurus* arrives at its complete external form when it has only grown to an inch in length, having by that time undergone all its morphological changes. The brephalos having quitted the ovum in a Megalopa stage, in the form known as *Phyllosoma*, about 1·5 mm. or 2 mm., in length, assumes the outward shape of its parent by the time it has reached the length of one inch.

Yet, while I write, I have before me a *Phyllosoma* nearly an inch long, in which all the characters of the brephalos as it quits the ovum of *Palinurus* are present, excepting the addition of new limbs. The question must therefore arise, whether our knowledge of

these animals is sufficient to warrant us in stating that all *Phyllosomæ* are the young of *Palinurus*, or some allied genus; if so, it is certainly remarkable that the brephalos undergoes no change while it continues to grow from the tenth of an inch to an inch in length, and that it then should undergo an immediate alteration, changing from a thin, translucent animal, to one thick, solid, and perfectly robust.

Synaxes, Spence Bate.

Synaxes, Spence Bate, Ann. and Mag. Nat. Hist., ser. 5, vol. vii. p. 220.

This genus consists of those species in which the rostrum is produced anteriorly beyond the extremity of the somite that carries the first pair of antennæ, and unites with that of the

Fig. 11.—Dorsal view of *Synaxes*.

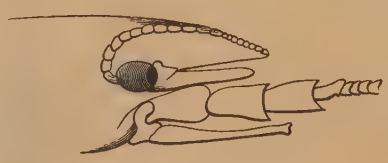

Fig. 12.—Lateral view of *Synaxes*.

second pair of antennæ so as to make a perfect orbit, and covers the ophthalmic somite as shown in the annexed woodcuts. The first pair of antennæ carries two short flagella.

Synaxes hybridica, Spence Bate.

Synaxes hybridica, Sp. B., *loc. cit.*, p. 220, pl. xiv. figs. 1–6.

No specimen in the Challenger collection.

Habitat.—West Indies.

Observations.—*Palinurellus*, v. Martens, according to that author differs from *Synaxes* in having the posterior pair of pereiopoda chelate in the female, and Boas in his Studier over Decapodernes Slægtskabsforhold, p. 183, considers it as the most primitive form of the Palinuridæ, and therefore nearer *Homarus*.[1]

Palinurellus gundulachi, Martens, was taken off Cuba.

Aræosternus, De Man, Professor Martens[2] considers to be the same as *Palinurellus*.

Aræosternus wieneckii, De Man, was taken off Sumatra.

Geological Range.—The genus *Palinurina* was established by Munster for species

[1] *K. Dansk. Vidensk. Selsk. Skr.*, Rk. 6, Bd. i., 1880; *Zool. Record*, 1881, Crust. p. 20.

[2] *Zool. Record*, 1881, Crust. p. 20.

found in the lithographic stones of Solenhofen and the lias of Southern England, it has the flagella of the first pair of antennæ long, and all the pereipoda subequal, the first pair not longer or more chelate than the others.

Palinurina pygmæa, Münst., *Palinurina longipes*, Münst., and *Cancrinus claviger*, Münst., evidently belong to this family, and probably also *Archæocarapus bowerbankii*, M'Coy, from the London clay; the last is remarkable for the length of the first pair of subchelate pereiopoda and the prominent rostriform character of the frontal margin of the carapace.

Development of the Palinuridæ.

The species belonging to the genera of this tribe are among the largest of the Crustacea Macrura, measuring as they frequently do some two feet or more in length. But although their dimensions are so great, yet their ova are among the smallest, measuring less than 1 mm. in diameter. As in most instances when the ova are small, their number is correspondingly large.

The young when it quits the egg measures 1·5 mm. from between the ophthalmopoda to the posterior extremity of the pleon. The legs, of which one single and four double branched pairs are already well-developed and longer than the animal, and previous to being hatched lie longitudinally rolled up, passing anteriorly between the ophthalmopoda and reaching over the dorsal surface of the animal to the posterior extremity of the cephalon. When it quits the ovum and throws off the first embryonic covering it appears in the form of what was long believed to be a perfect animal, the *Phyllosoma*. At this period, in specimens that I have taken from the ova of British species (Pl. XIIa. fig. 1), the central ocellus is very conspicuous, and placed between the ophthalmopoda which are largely developed and distinctly pedunculated, the ophthalmus being large and massive, and the peduncle rapidly narrowing to a slender attachment. The two pairs of antennæ are only uni-branched, and as yet do not appear to be articulated. The mandibles are present and perhaps one of the siagnopoda.

The pereion is not covered by the carapace but consists of six somites dorsally fused together, and carries five pairs of pereiopoda, of which the first is small, slender and uni-branched; the others are biramose, the second branch, articulating with the distal extremity of the basis, is multiarticulate, consisting of six subequal joints including the two basal, which are homologous with the coxa and basis.

The pleon is short, showing at the sides the divisions which mark the number of its somites.

Unfortunately the young are very difficult to rear, and although they have been occasionally hatched in artificial aquaria,[1] none have yet been known to pass into the second stage of development.

[1] The late Mr. Alfred Lloyd informed me that in the aquarium at the Crystal Palace the young of the *Palinurus* when first hatched hung in the water as a cloud in the form of an inverted pyramid for some time—two days, if I remember correctly—and then gradually dispersed.

No doubt there are large numbers in the sea, and these are occasionally taken, but though the adult is common[1] on our south western coast, yet the *Phyllosoma* form has only been taken occasionally as solitary specimens. In the warmer latitudes they have been more frequently captured, from the length of 1·5 mm. to that of 30 mm., but these being from different as well as distant localities are undoubtedly the young of different species or perhaps even genera.

The smallest, and as we may suppose the youngest form (Pl. XIIA. fig. 2), taken by the Challenger off Samboangan, is about 1·5 mm. in length, corresponding to that of the young when it quits the egg. It differs from the more immature form (fig. 1) that I have taken from the ovum of the European species, in having the vitellus entirely absorbed, and in having the various hairs that fringe the appendages liberated from the embryonic case and freely extended. The central eye or ocellus is distinct; close behind (fig. 4) and connected with it, is a small circular transparent body that I take to be a lens, posterior to this again and lying transversely is a narrow line of rigid integument that I take to be the ventral surface of the first or ophthalmic somite. It extends from the base of one ophthalmopod to that of the other, where it probably blends with the membranous articulation. The ophthalmopod is long and cylindrical, and suddenly expands at the base of the ophthalmus. On each side of the median line, a little posterior to the ventral ridge of the first somite, are two small bodies that appear to be the nuclei of a mass of nerve matter that surrounds them. This neural substance passes back in two gradually narrowing lines, one on each side of the oral apparatus, from whence I was not able to trace it until it reaches the pereion, where it reappears in the form of three double lobes corresponding with the three posteriorly developed pairs of pereiopoda. The mandibles possess a rigid character and a long calcified tendon that extends nearly to the base of the second pair of antennæ. I have not been able to determine whether the synaphipod be present, neither can I determine in this solitary specimen whether the first pair of siagnopoda be developed. The first pair of pereiopoda consists of a small, unbranched, well-formed appendage, it has only six joints, very short, and terminates in a sharp pointed dactylos.

The second pair is also six-jointed, it is very much longer than the first, is biramose, and terminates in a long and slender dactylos.

The third and fourth pairs of appendages are seven-jointed and resemble each other, except that I could only determine the presence of a long spine-like tooth at the distal extremity of the ischium in the third pair, whereas in the fourth there is a prominent one present on the basis, ischium and meros also. There is, moreover, a small branch attached to the coxa; this is homologous with the mastigobranchia in the adult animal, and exists on the third and fourth pairs of pereiopoda, but not, so far as I could deter-

[1] The late Mr. Laughrin of Polperro informed me that one man took, a short time since, as many as sixty-four in one night off Kedgwith near the Lizard, and frequently as many as fifty.

mine, on any of the others. The pleon is short and without any evidence of possessing appendages.

The specimen next in size is from the Celebes Sea (Pl. XIIA. fig. 3) and is 7 mm. in length. That is, it has increased in dimensions about five times without any very great variation in form or growth of parts, and as there is in the development of separate species of the same genus and generally in different genera of the same family the same structural characters, I shall consider the several specimens taken as being successive stages in their relation to each other. The ocellus is still very distinct, and the ophthalmopoda have increased in length considerably and become biarticulate, one articulation at the base and the second at the root of the ophthalmus, which is long and pear-shaped. The first pair of antennæ is biarticulate but not biramose. The second shows evidence of becoming so, but not very conspicuously; at its base a series of cells are arranged in the form of a circle, and behind this the green gland appears in an incipient stage. The hepatic lobes, which in the previous stages were large and few, are here increased in number and arranged in a series of cæca symmetrically disposed on each side of the carapace, and which empty themselves into a longitudinal duct that is united with the main viscera near the stomach and above the oral apparatus.

The mandibles are distinctly visible, sharp-pointed, and enclosed between the cheiloglossa and the metastoma or posterior lip, behind which, and clasping it closely, the first pair of siagnopoda is visible, in form somewhat resembling that of the adult. The distance from this latter organ to the anterior margin of the pereion is considerable, corresponding as this does with the posterior margin of the cephalon. At the anterior angle of the pereion is a pair of biarticulate appendages, short and rudimentary, the second joint being shorter than the first. Near this is a second small but well-developed pair of unbranched five-jointed limbs, a few hairs existing on the two terminal joints; this is the first pair of gnathopoda. The next and three following pairs resemble each other; they are biramose, rather longer than the animal, seven-jointed and carry a long basecphysis. The next succeeding, or seventh pair of appendages is short and feeble, being in an immature condition; it is four-jointed and carries a small basecphysis. Posterior to this pair and situated in the angle formed by the union of the pleon with the pereion there is a small vesicle, the germ of another pair of appendages. The pleon is small and without any evidence of the future appendages.

The next specimen, and one which has the appearance of being the young of the same or a closely allied species, is from the West Pacific, and is about 14 mm., or double the length of the preceding (Pl. XIIB. figs. 1–3).

The central eye has become reduced in size. The ophthalmopoda are two-jointed.

The first pair of antennæ has become four-jointed and biramose, the smaller branch springing from the distal extremity of the third joint. The second pair of antennæ is five-jointed and exhibits on the metope or ventral surface near the base of the antennæ a

small circular foramen, the rudiment of the future phymacerite, connected with which is the incipient green gland. The appendages of the mouth are assuming the permanent form, but as yet I have not been able to determine the future synaphipod, but the calcified tendon is seen as a long thread reaching to the second pair of antennæ. The first pair of siagnopoda, so far as I can make out, is the only pair of oral appendages yet present.

The small two-jointed appendage attached to the anterior angle of the pereion is still a feeble and unimportant organ. The next in succession is unbranched and pediform, but appears not to have increased in length or in importance.

The next five pairs are of the same relative value. The penultimate pair has increased until in size and appearance it resembles the preceding pairs, while the ultimate still remains in the form of a small elongated vesicle, to the proximal extremity of which small muscles are attached. It is more distant from the angle that is formed by the union of the pereion with the pleon than in the form shown in fig. 3, Pl. XIIA.

The pleon exhibits on the ventral surface five pairs of marginal papillæ that increase but little in size posteriorly until the sixth pair, which is more developed and exhibits signs of being pendulous and bilobed.

The next specimen was taken off Kandavu, one of the Fiji Islands, and is 15 mm. in length.

The difference between this specimen and the preceding is very slight, none being appreciable in the progressive development, but the carapace is somewhat broader in proportion to its length, which is probably due to its being the young of an approximate or variable species.

Our next specimen in point of size, was taken at the Cape Verde Islands. It is 22 mm. in length, or 7 mm. longer than the previous one which was taken off the Fiji Islands. It differs little in structure, but the oral appendages have approached nearer to the pereion, and the other pairs assimilate to those of the preceding stage except the posterior pair of periopoda which have increased in length but are still unbranched, biarticulate, and in an immature condition. The pleopoda are all produced as biramose appendages, the branches being each attached to a small basal joint. The posterior pair is the largest, as might be anticipated from its earlier appearance and future condition. The pleon has increased from 1 to 4 mm. in length.

The other specimens in the collection are from St. Thomas Island, West Indies. There are three of the same species, one of which is 15 mm. in length and corresponds in development with the preceding; another is 30 mm., and the third is 35 mm. in length; a fourth specimen (Pl. XIIc. fig. 1) evidently belongs to another species. None of these probably are the young of those species which are known in the more western longitudes, but their study must throw some light upon the relative growth of parts during the development of the animal.

The length of the smallest of these specimens is double that of the largest of the preceding, and consequently we should expect to find a considerable amount of progressive change,

but, remarkable as it may seem, this is not the case. Had these West Indian specimens been taken in the eastern seas, we should have been prepared to consider them as being of some known species obtained there, from their resemblance in all important features.

The central eye has become relatively small and appears to be connected with the carapace, or perhaps more correctly speaking is situated behind the somite that carries the ophthalmopoda. The ophthalmopoda, slightly decreasing in their comparative length, are still two-jointed, and are now distinctly attached to a somite that is separated from the carapace. The first pair of antennæ has the two flagella in an embryonic condition varying little from that seen in the last preceding description. The second pair of antennæ has four distinct joints, the three basal are subequal, the fourth is longer than the three preceding, slightly tapering, and commencing at its base to be divided into annuli. Upon the metopal surface of the carapace an ovate foramen exists, the connection of which with the green gland is apparent, and at its side is a second glandular body, smaller and of different structure. Near this, on the wall of the carapace, may be seen the feathery extremity of the long and slender calcified tendon that raises and closes the mandible, to which it is attached on the under side near the upper extremity of the apophysis. The metastoma exists as two circular foliaceous plates, behind which may be seen the two foliaceous branches of the first oral appendages, which as yet are immature. The stomach is becoming visible above and posterior to the oral apparatus, behind which it is mostly hidden. The distance of this from the next succeeding pair of appendages is proportionally less than in the preceding specimens, but even now it is equal to half the distance of the oral apparatus from the frontal margin of the carapace. The next in succession is the small pair that in the preceding specimens corresponds to the anterior angle of the pereion. It now consists of a basal joint, to which are attached a large and a small foliaceous plate. The next succeeding pair of appendages still retains the unbranched pediform character, but is furnished with a strong spine at the extremity of the propodos besides a few less important hairs. This spine is as thick and as long as the dactylos and gives the appendage a chelate appearance, which is probably a specific rather than a developmental character. The three next succeeding pairs retain the same character as in the younger and more early stages. The pleon has increased in length a little, and all the pleopoda are present as pedunculate biramose appendages, agreeing in character with the permanent form, but still immature; the cilia that fringe the margins being yet undeveloped, and a small notch existing where the future stylamblys will be. The posterior pair as yet merely repeats the form, but is larger and has a small prominence on the outer ramus, where the future external tooth will be situated; this is still more prominent in the underlying dermal tissue that is apparent beneath the surface.

The next largest specimen is from the same locality as the preceding, St. Thomas in the West Indies, and is 35 mm. in length. The appendages have very nearly the same relative proportion; the pleon is still short, being only 7 mm., or one-fifth of the

entire length of the animal; the posterior pair of pereiopoda is still very short, being only 4 mm. long as compared with 30 mm., the length of the first pair, which is the only one not broken, and which is generally but little more than half of the second and third. Up to this stage, the most advanced in the collection, the animal still retains its *Phyllosoma* condition, without the slightest sign of any branchial structure whatever. The nervous system gradually becomes more definite in character but as yet the pereionic ganglia are distinct from each other both longitudinally and laterally. The cerebral mass consists of three lobes, the frontal and two lateral. The former supplies the organs of vision, the latter send large branches to the antennæ, while one or two small branches there subdivide and go to the antennal gland, which in this larger specimen appears to consist of a number of thick-walled convoluted chambers or cavities.

From the cephalic ganglia two long slender nerves go directly back to the oral apparatus, which they pass, one on each side, and continue until they enter the pereion, where they enlarge and unite to form a long wavy mass, from which small lateral branches are given off apparently to join the gnathopoda and the anterior appendages which, as yet, are in an immature condition. Passing from this ganglionic mass, the neural cord divides and forms double ganglia, in three successive pairs, which go respectively to the three anterior pairs of pereiopoda. The next supplies the fourth pair but differs from all the preceding in consisting of four ganglionic masses forming a quadrangle.

The fifth pair of pereiopoda is as yet in a very immature condition, but whether from injury to the specimen in mounting or from some other cause, I can find no corresponding ganglionic centre. Whether the posterior or quadrangular group of ganglia supplies it I could not determine, although I am induced to believe it does, but the space between this and the next ganglion was obscure.

The next and following ganglia differ from the preceding in being spherical and in having no central division; they are close together, and each ganglion is nearly as large as the somite that it supplies is long; there are only five ganglia, and these correspond to the five anterior somites of the pleon; none were visible in the sixth joint and telson.

The next specimen is evidently the young of another species, and agrees closely with that which Milne-Edwards has described and figured under the name of *Phyllosoma stylicornis*,[1] but it has the cephalon narrower anteriorly and proportionally longer (Pl. XIIc. fig. 1). It is 30 mm. in length, and was taken off St. Thomas Island, West Indies, in the month of March, whereas that of Milne-Edwards is recorded from the Indian Ocean. Its most remarkable feature is, that although it is one of our largest specimens, the pleon is not more than 1 mm. in length, and none of the pleopoda are present except the posterior pair, and these are in a rudimentary stage. On the other hand all the pereiopoda are as far advanced as those of the preceding specimens, and the posterior pair is very much more so, and stands at the extremity of the posterior angle of the

[1] Hist. des Crust., vol. ii. p. 483, pl. xxviii. figs. 1–7.

pereion which is considerably more extended than in the preceding specimens, and leaves the pleon embayed in a fork of considerable depth.

The eyes are supported on long, slender, bi-articulate ophthalmopoda. The first pair of antennæ has the peduncle tri-articulate and supports two flagella, of which the larger is furnished with a number of membranous cilia, which I believe to be auditory in their function; the smaller is slender and in an incipient condition: the second pair of antennæ is short, tapering, and multi-articulate; at its base, situated within the margin of the carapace, is the foramen of the future phymacerite, and leading up to it the cellular substance of the green gland, whose walls appear more delicate than those of the preceding species: the oral apparatus is hard and firm, and the long, slender calcified tendon of the mandible is threadlike and extremely delicate: the first pair of siagnopoda is two-branched, curved and armed with several strong spines, some of which are fringed with minute pointed processes, and the whole apparatus is in close contact with the anterior extremity of the pereion, the anterior angle of which supports a small two-jointed appendage similar to that which we found at earlier stages in the other specimen; on the outer side, also, there exists a small rudimentary process which is not seen in either of our other specimens, and which Milne-Edwards figures[1] as being the incipient stage of "les mâchoires de la deuxième paire et la première paire de pattes-mâchoires"; the next as well as the five succeeding pairs, appears to be in a similar condition to those of the preceding example, but the seventh or ultimate pair is considerably longer and quite equals in size the largest of the preceding, a circumstance that is more dependent upon specific than upon developmental differences, since the specimens of other species which are larger in size have their posterior pair in a much more immature condition.

Again, in this present specimen the pleon is in a very immature condition, none of the pleopoda being beyond the early budding stage except the posterior pair, and that but slightly advanced.

Development of the Scyllaridæ.

The foregoing paragraphs contain an account of the development of the Palinuridæ, so far as the specimens in the present collection enable me to trace it; but some others in my possession, which were obtained on the coast of Coromandel, by Sir Walter Elliot, still further illustrate the progressive changes in the genera of the Scyllaridæ.

The specimens appear to me to be identical with that described by Desmarest under the name of "Phyllosome larges-cornes," and by Leach as *Phyllosoma laticorne*, but which from the character of its antennæ appears to belong rather to the Scyllaridæ than to the Palinuridæ. The progressive development of the young of the two families is probably so nearly similar, that the history of one would be the repetition of the other. Our specimens, which are numerous, are only 16 mm. in length, or about half that of the

[1] *Loc. cit.*, pl. xxviii. fig. 3, *c.d.*

largest of the specimens previously described, yet in many parts they have advanced further in characteristic development (Pl. XIIc. fig. 2).

The ophthalmopoda are still long and biarticulate, the stalk being long, slender and cylindrical, the eye at its extremity being long and pear-shaped.

The first pair of antennæ affords evidence of its permanent form; it has a peduncle of three subequal cylindrical joints which terminate in two short flagella, the inner of which is slender and cylindrical, while the outer is flatter, broader and sharply pointed, and on the convex side supports a few membranous cilia.

The second pair of antennæ is three- or four-jointed. The joints appear within an outer case that is less articulated (Pl. XIIb. fig. 4*c*). The first is short and cylindrical, the second is long, flattened, and produced to a sharp point at the outer distal angle, the third is short and cylindrical, and the fourth or last is flat, wide and produced to a point. Within the outer integument, which is next to be shed, the structure exhibits the appearance of a series of narrow lobes at the margin similar to those that we see in *Scyllarus* and *Arctus*. The distance of the antennæ from the oral apparatus is a little less than half the length of the animal, and is occupied by distinctly formed hepatic lobes arranged in a beautifully radiating series of branches. The mandibles are smaller than in the preceding specimens, but the calcified tendon is long, slender, and feeble as compared with those of the preceding specimens. I could detect no synaphipod, and the apophysis is broad and of extreme tenuity.

The first pair of siagnopoda (Pl. XIIb. fig. 4*e*) is two-branched, and lies closely attached to the double lobed *metastoma;* the two branches are tipped with three or four hairs on each, which from their relative proportion appear like important spines; the second pair of appendages (fig. 4*f*) is in the form of a flat oblong plate, and corresponds with that of the adult; two small branches are also visible within a common outer sac.

The next pair (fig. 4*g*) is in a very incipient stage, and consists of a simple elongated sac, without exhibiting any evidence of its future condition. An example of this is likewise seen in *Phyllosoma brevicorne*, Leach,[1] which induces me to think that both forms belong to a genus of Scyllaridæ.

The next pair of appendages (fig. 4*h*), which I believe corresponds with the first pair of gnathopoda, is developed in the form of a true leg; it is only five-jointed, and carries a long sub-cylindrical branchial sac attached to the coxa or first joint; the second joint is long and cylindrical, except for a small lobe or projection that exists on the outer surface, one-third distant from the coxal joint; the next two joints are subequal and of the same diameter as the last, whereas the one or perhaps two terminal become suddenly smaller and tapering, terminating in a fine spine: the next pair of legs corresponds to the second pair of gnathopoda; it is pediform, long, slender, and in all our specimens is broken off more or less shortly; attached to the coxa is a single subcylindrical branchial sac. The next four pairs are also broken off, but the fragments remaining in the bottle show

[1] Milne-Edwards, Hist. des Crust., vol. ii. p. 482.

them to be pediform, cylindrical, biramose, terminating in a strong and sharp dactylos, and furnished at the base with two subcylindrical vesicular branchiæ: the seventh or terminal pair of pereiopoda is considerably shorter than the others, it is five-jointed and furnished neither with branchia nor ecphysis.

Anteriorly the pleon corresponds in width with the posterior portion of the pereion and tapers a little towards the caudal extremity. The external angle of each somite is posteriorly rounded, and the telson approaches the form of that in the permanent or adult stage,—being rounded and membranous at the extremity, and armed on each side with a small sharp tooth. The pleopoda as yet are in an immature condition, consisting of a stout peduncle and two slender subcylindrical rami, except the posterior, which has the peduncle short and the branches broad and foliaceous, making with the telson a well-formed rhipidura.

In neither of the specimens that belong to the Palinuridæ have I seen any trace of a branchial organ, but in those of the Scyllaridæ I find them attached to all the legs from the first pair of gnathopoda to the penultimate pair of pereiopoda, the ultimate, as in the adult stage, being without any. Not only are they attached to the legs but some are attached to the walls of the pereion also. Examination with a higher power shows that those attached to the coxæ of the legs are double-branched, while all the others are single, but in pairs. Examination of the structure demonstrates that within these sacs the future branchiæ exist in the form of trichobranchiate plumes, excepting in those attached to the coxæ of the legs. These consist of two sacs attached at the base to one stalk; one of these sacs contains a branchial plume, the other a branchial lash; the one becomes the podobranchia, the other the mastigobranchia. The other sacs are evidently the arthrobranchiate and pleurobranchiate plumes in an incipient state.

Turning now to a very different stage of the young *Palinurus*, there will be found in this Report one or two specimens that have reached the permanent form, and are 27 mm. or scarcely more than one inch in length.

Sir Walter Elliot captured at Waltair, on the coast of Coromandel, a specimen of *Palinurus* that was only 18·25 mm. in length. It was smooth and opaline, with antennæ three times its own length. All its appendages were well-developed, and there is little doubt that it was the young of some probably known species.

If we compare this with the length of the large *Phyllosoma* of *Palinurus*, we find that the smallest adult form is nearly half an inch shorter than the largest immature form, and that the largest immature form has not yet sufficiently advanced in development to possess branchiæ; that the pleon, which in the adult condition is more than half the length of the animal, is still in a rudimentary condition, the pleopoda as well as the rhipidura being only in the early stage of gemmation (Pl. XIIc. fig. 1).

Judging, however, by the analogy of what we do see in the *Phyllosoma* of the closely allied form of *Scyllarus*, we may safely infer that, corresponding with the development of

the pleon, the carapace gradually projects from the cephalon over the pereion, and the several appendages assume a more permanent character without any sudden change of parts.

Phyllosoma furcicaudatum (Pl. XIID. fig. 1).

This specimen, taken at St. Vincent on the 26th April 1876, at the surface, is 6·5 mm. long, and has a peculiar form of caudal termination to the pleon, from which I propose to name it, until its relation to the adult form is determined.

In general appearance it corresponds to the more advanced form taken off the coast of Malabar by Sir Walter Elliot, and I believe it to be a younger stage of some genus of the Scyllaridæ, and as several specimens of *Ibaccus* have been found in that locality, it is not improbable that it may be the young of that genus.

The ophthalmopoda are long, but do not extend laterally as far as the margins of the carapace: the ophthalmus is pear-shaped and about one-third of the length of the ophthalmopod.

The first pair of antennæ is slender and carries a short branch at the base of the outer flagellum which supports at the apex a few membranous cilia; the second pair of antennæ is longer than the first, slender, and armed on the outer side, at about one-fourth its length from the base, with a strong tooth-like process, which in a stage further advanced is probably developed into the outer marginal angle of the great squamiform joint of the peduncle; the rest of the appendage appears from its multiarticulate condition to resemble the long flagellum in the other families of the Macrura.

The second pair of siagnopoda exists in the form of a short squamose plate.

The third pair consists of a small circular tubercle.

The gnathopoda and the four anterior pairs of pereiopoda correspond with those of the more mature forms in all excepting what may be specific characters. The Cape Verde specimen is armed with large teeth attached to the several joints of the pereiopoda near the articulations. In the specimen from Waltair, in which the legs are free from this kind of armature, there are no branchiæ yet developed, and the posterior pair of pereiopoda is still in an incipient stage of gemmation.

The pleon is remarkable; it shows no sign of segmentation, and terminates in two long tooth-like processes, one at each posterior angle, each process being firm, rigid, and nearly as long as the pleon.

Phyllosoma verdense (Pl. XIID. fig. 2z).

Habitat.—Taken at St. Vincent, Cape Verde Islands, on April 26, 1876, at the surface. Length 2·5 mm. to 3 mm.

Two specimens of this species were taken associated with *Phyllosoma furcicaudatum*. For temporary convenience I shall designate them after the locality at which they were taken, although I believe that they are the same species at different ages. The smaller one is little larger than the length of the brephalos when it quits the ovum. The second corresponds in all respects excepting that it is a little more developed. They both resemble *Phyllosoma furcicaudatum* in all the appendages that are developed, excepting the ophthalmopoda, antennæ, and pleon.

The ophthalmopoda have the peduncle and the ophthalmus subequal in length, the latter is pear-shaped and articulated with the peduncle.

The first pair of antennæ is single-branched, cylindrical, and nearly one-third the length of the carapace.

The second pair resembles the first both in size and length.

The second pair of siagnopoda is biarticulate, but small and rudimentary (Pl. XIIᴅ. fig. 2*f*).

The third is not yet present.

The two pairs of gnathopoda and the three anterior pairs of pereiopoda are well developed, and correspond nearly with those of *Phyllosoma furcicaudatum*, excepting in having the dactyli comparatively longer, as well as the several spinous teeth upon the respective joints also.

The fourth pair is present in the form of incipient buds, while the fifth pair is not as yet represented.

The pleon is feeble, cylindrical, and terminates at the external lateral angles with a small tooth and a minute hair (Pl. XIIᴅ. fig. 2z).

Phyllosoma philippinense (Pl. XIIᴅ. fig. 3).

Habitat.—Taken off the Philippine Islands, October 23, 1874.
Length 2 mm.

This species corresponds very closely with that taken off Samboangan, and is no doubt closely related to it. It differs somewhat in the form of the ophthalmopoda, as represented in the plate, but I am inclined to believe that those of *Phyllosoma samboangense* are altered in form from the manner of preservation. All the appendages are similarly developed and show the same characteristic features, except that the posterior pair of the developed pereiopoda, which correspond to the third pair in the adult, has no basecphysis, but has on the posterior margin, one-third from the coxal articulation, a strongly formed tooth-like process; the morphological value of which is yet to be determined.

The pleon is slightly tapering, and terminates on each postero-lateral angle with a small tooth (Pl. XIIᴅ. fig. 3z).

This species and that from Samboangan are doubtless the same, although the caudal termination is rounded in the latter, and bifid in *Phyllosoma philippinense;* the basecphysis is absent from the third pair of pereiopoda.

These two species, moreover, correspond closely with two taken off the Cape Verde Islands, in the Atlantic, that are of the same size and of similar condition of development. I am inclined to believe that both forms belong to the same genus as *Phyllosoma furcicaudatum*, and this probably is generically related to some species belonging to the Scyllaridæ, and probably to the genus *Ibaccus*.

Tribe Astacidea.

Family Eryonidæ.

Cephalon dorsally depressed, having no rostrum. Lateral margin of the carapace horizontally compressed and serrate; broader than the pleon. Eyes wanting or abnormal; first pair of antennæ supporting two multiarticulate flagella. Second pair having a scaphocerite, and a long multiarticulate flagellum. Gnathopoda pediform. Pereiopoda seven-jointed; first three pairs chelate; posterior pair reversed, chelate occasionally in the female, smaller than preceding. Pleopoda, except the first and sixth pair, having a stylamblys. Outer branch of sixth pair without a diæresis. Telson tapering.

Observations.—Professor Camil Heller in 1863 described in his "Crustaceen des südlichen Europa," under the name of *Polycheles typhlops*, a small Crustacean, of which he only had a male specimen, found in the collection of the Museum at Vienna. It was supposed to have been taken in the Mediterranean, somewhere near the island of Sicily.

Its interest appears to have been much overlooked by naturalists, until Sir Wyville Thomson published, in Nature, May 15, 1873, ten years after Camil Heller's description, some notes by Dr. v. Willemoes-Suhm of the Challenger, upon a closely allied form that was dredged on the 4th of March preceding in the middle of the North Atlantic, at a depth of 1900 fathoms or rather more than 2 miles from the surface. To this animal the describer gave the name of *Deidamia leptodactyla*, the generic name of which was afterwards withdrawn, because it was found to have been given previously by Dr. Clemens to a genus of North American Lepidoptera, and the name *Willemœsia*, out of compliment to the ill-fated naturalist of the Challenger, was given to it by Dr. Grote in 1873.[1]

The great depth from which it was dredged, a depth that was previously believed to be barren, if not of all life, certainly of animals so high in the scale of existence, the apparent absence of the power of vision, and the relationship of the animal to forms of Crustacea that were supposed to have been extinct since the period of the Liassic Limestone of England and the Upper White Jura of Bavaria, gave a considerable degree of interest to the discovery. Shortly afterwards a second smaller species in shallower, but still

[1] *Nature*, vol. viii. p. 485.

deep water was taken off Sombrero, one of the eastern group of West Indian Islands, at a depth of 450 fathoms, which, from its general resemblance to the fossil genus *Eryon*, excited peculiar attention, and subsequently the Challenger obtained from even greater depths and in very distant localities many specimens that very closely resembled one another in general appearance. Since then species have been taken by Professor Agassiz in the West Indian Seas, and in the Mediterranean by Professor A. Milne-Edwards.

Detailed examination of the specimens from the several localities demonstrated that however closely they may resemble one another in external form, they yet exhibit important variations showing that they are not so intimately allied as appearances might suggest.

In some the external arrangement of the numerous teeth and spines varies without any modification of the structural form, whereas in others the external characters appear to be fixed and the internal structure undergoes a considerable amount of important variation.

The chief anatomical feature, and one from which all the other peculiarities of form arise, is its flattened and dorsally depressed character, particularly at the anterior extremity, where the frontal margin is so closely compressed upon the antennæ that they are flattened at the base, and implanted almost in the same horizontal line, while the ophthalmopoda are forced between the second antennæ and the external lateral angle of the carapace, so that the utility of the organ of vision is reduced to a minimum. In the genus *Willemœsia* the ophthalmopoda appear to be obsolete, and in *Eryoneicus* to be entirely absent. The antero-lateral angle of the carapace in this group of Crustacea is represented by what Stimpson has called the "spina antennalis" in the more cylindrical and common forms. This angle, which is not appreciable in *Astacus* and *Homarus*, and only represented by a short tooth in *Palinurus*, is produced to a marked degree in *Arctus* and *Ibaccus*, where, in the latter especially, it is carried to a very considerable extent outwards. But in *Polycheles* and in *Arctus*, instead of being directed laterally outwards, it is produced in the same manner, forwards and outwards. The orbit being in a similar position, and formed in a similar way, in the Scyllaridæ and Eryonidæ, the consequence is the degradation of the organs of vision and the reduction of size and alteration of form of the orbit, which in some species of the Eryonidæ results in the almost total suppression of the ophthalmopoda.

Ranging from the anterior or antennal tooth, the line of anatomical depression produces a lateral crest that longitudinally defines the dorsal from the ventral surfaces of the carapace; it resembles the lateral margin of the carapace in the Brachyura, but is not homologous with it. In the Brachyura the marginal angle corresponds with the external angle of the orbit, or, according to Stimpson's nomenclature, the "angulus orbitæ externus;" the antennal angle, or "spina antennalis," being carried under, forms the inferior margin of the orbit, whereas in *Polycheles* the inferior surface of the orbit is imperfect, the eye appearing dorsally in a cleft between the frontal and the anterior

angle of the antennal regions, and ventrally between the upper surface of the second antenna and the under surface of the antennal region (Pl. XIII. figs. *a b c*).

The dorso-lateral margin of the carapace forms an angular ridge, and is divided more or less distinctly into three portions in separate species. These divisions correspond to those seen in the Scyllaridæ, as exemplified most clearly in *Arctus orientalis* (Pl. IX. fig. 4); the anterior represents the line of the cervical fossa, while the posterior may be called the siagnotic fossa, as the space between the two is occupied by the siagnos, or mandible, and may well be termed the siagnotic region. This latter sulcus, although strongly defined in some species both in the Scyllaridæ and in the Eryonidæ, is in others less appreciable, and disappears in *Ibaccus*, and is determinable only by an analytic examination in the Astacidæ.

These several divisions of the carapace in the animals belonging to the Willemœsian group are defined by a series of sharply-pointed teeth that differ in number and vary in size and proportions in different species, and may safely be used as a convenient and fairly reliable sign of specific structural difference.

In the dorsal median line there is a longitudinal carina more or less important, culminating in strong teeth on each somite of the pleon, and taking the unusual direction of pointing forwards. It commences on the frontal margin of the carapace, and terminates in the anterior extremity of the telson. On the carapace it is scarcely more prominent than a small ridge that in some species is only granulated. It is generally armed with teeth on the posterior margin of the cervical sulcus, the gastric region, and the frontal margins, where one or more generally stand in an oblique position behind the edge, which is not produced to a point or rostrum as in *Astacus*, &c. These teeth correspond with those in the same position, and further resemble them in being sometimes double in *Arctus* and allied genera, but are more robust. One peculiar feature in the external structure of these animals is the manner in which the first somite of the pleon interlocks with the carapace. In *Polycheles* and *Pentacheles* a tubercular process (peltecleis) of the posterior margin of the carapace projects obliquely backwards (Pl. XVI. fig. 4), and overlaps the anterior margin of the first somite of the pleon, while the lateral extremity of the first somite, or that portion which is laterally external to the tubercular process of the carapace, is directed forwards, and overlaps the posterior marginal angle of the carapace.

In the genus *Willemœsia* the interlocking is different. There the peltecleis, instead of overlapping the anterior margin of the first somite of the pleon, projects into a hollow socket beneath the anterior margin of the same somite, and acts as a bolt and joint (Pl. XX. fig. 1). In the Scyllaridæ there is no peltecleis, but the anterior lateral margin of the first somite of the pleon overlaps the posterior lateral angles of the carapace, and so securely holds it down.

In the Palinuridæ a lateral process of the first somite of the pleon overlaps the

posterior margin of the carapace. There is no peltecleis attached to the carapace, but a tubercular process, different in form but fulfilling the same purpose, is attached to the pleura of the posterior somite of the pereion, just above the articulation of the last pair of pereiopoda, and behind the base of the pleurobranchia, and may be called a pereicleis, as it serves to bolt down the carapace to the pereion, which it does very effectually by being inserted into a hollow formed in the internal surface of the carapace, which fits closely beneath the overhanging margin.

All the somites of the pleon articulate with each other by means of a lateral process produced from the anterior edge of one somite articulating into a cup or hollow situated in the latero-posterior margin of the preceding somite. The anterior half of each somite is smooth and adapted to be retracted beneath the preceding somite when the animal is extended, and the overlying margin of each is furnished with a small fine fringe of cilia that protects the sub-internal division from the introduction of any fragments of foreign and irritating matter.

The rhipidura or tail-fan is large and well developed, and the powerful muscles of the pleon evidently enable it to strike with considerable force, so as to allow the purblind creature to dart backwards with great rapidity on the most sudden alarm.

The eyes are carried on an ophthalmopod in *Polycheles* and *Pentacheles*, which is altered in character (Pl. XVI. fig. 3c, *a*) and rigidly attached to the cephalon on the inner side, while it is only closely compressed and covered by, but not fused with, the antero-lateral angle of the carapace on the outer side. The base of the ophthalmopod is lodged in an irregular orbit, which has a tendency to a slight degree of variation of form that is useful in assisting to determine species.

The first pair of antennæ (fig. 1c, *b*.) in the several genera is formed on the same type. The tendency to specific variation in this appendage is mostly limited to the alteration of the crest-like process that is formed by the broad and thin exterior of the inner margin of the first or coxal joint. In *Eryoneicus* it is reduced to a prominent tooth, whereas in other genera the extended surfaces of this joint meet in the median line, and by pressure against each other force themselves upwards and form a central crest-like ridge. This crest is variously fringed with teeth and hairs, and is sometimes pointed and sometimes rounded in front. In the interior of this joint is situated the acoustic apparatus (Pl. XIX. *b*. *a.c.*), which consists of a calcareous chamber connected by a calcified channel to the upper surface, where there is a long and narrow fissure guarded by strong teeth, which varies in number in different species, or they may be absent, as in the genus *Willemœsia*. The other two joints, as well as the flagella, appear to exhibit no great degree of variability, as the segments are always cylindrical, and the flagella unequal in length to a degree that is common to all the recent family.

The second antenna (Pl. XIX. *c*.) varies little from the general external character seen in the Macrurous type of Crustacea. But what variation there is appears to be peculiar to the group. There are only four joints forming the peduncle; the scaphocerite,

apparently articulates with the second, a circumstance demonstrating that the second and third are fused into one more solidly in the Macrura generally, but the most singular feature is the peculiar form and proportion of the phymacerite (Pl. XVII. *c. o.p.* and Pl. XIX. *c. o.t.*). The first joint or coxa of the antennæ articulates freely with the metope, a circumstance that distinctly separates it from the Palinuridea, and from its inferior or ventral surface a hollow calcified tubercle springs, as is common in all the Macrurous types, but in this family this tubercle or phymacerite is produced to a considerable length, it is turned inwards and then curves upwards and presses its extremity strongly against the under surface of the first antenna, where it is received into a depression. The extremity of the phymacerite is closed by a membrane of delicate appearance, and there seems to be no free opening; but in a specimen of *Stereomastis suhmi* that I closely and carefully examined, there appears to be near the centre a crescentic line that may be a fissure, as shown in the accompanying illustration, although I could not demonstrate it to be so. Around this fissure, which was situated near to one extremity, there existed, parallel to the outer open margin of the tubercle, a band of more solid structure divided at the top and bottom. Whether this be a kind of sphincter muscle for the purpose of closing the crescentic orifice, I am not prepared to say. The margin is generally fringed with more or less conspicuous hairs.

Fig. 13.—Phymacerite of *Stereomastis suhmi.*

The oral cavity is large and spacious, but capable of being entirely closed by membranous tissue which forms an anterior and a posterior fleshy protuberance; the former passes under the mandibles anteriorly, and apparently fulfils the functions

Fig. 14.—*Pentacheles enthrix.* "Mandibles, with anterior and posterior lips. Between them the oral aperture and two feeler-like appendages, mandibles without palpus. Enlarged four times." From a drawing and note by Willemoes-Suhm.

Fig. 15.—*Pentacheles enthrix.* "One of the points of the feeler-like appendages magnified $\frac{1}{4}$th power. The chitin-layer is removed in order to show the reticular tissue which fills up the inner structure. Three small glandular masses are shown in the skin, of which no doubt others are to be found all over the organ." From a drawing and note by Willemoes-Suhm.

of a tongue and lip, and may be conveniently named the cheiloglossa, while from the hinder portion of the posterior lip a membranous base with a lateral process (Pl. XX. *d''*), the metastoma, is produced on each side; it is long, tapers to a blunt point, and clasps the mandibles closely round the constriction at the base of the psalisiform blade.

In Willemoes-Suhm's figure they are shown as existing anterior to the metastoma as if not part of the same. A short œsophagus leads to a widely-distended stomach, which appears to be little more than a simple sac of large proportions that opens into a second or pyloric chamber (Pl. XIX. *plc*), whose upper or dorsal surface is armed with four large serrate plates, two of which, curved inwards, are attached to the surface, while a smooth calcareous plate lies on the lower surface. The pylorus passes into a straight alimentary canal that terminates at the anterior or broader part of the telson, as shown in the annexed illustration.

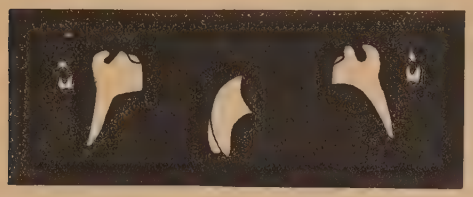

FIG. 16.—"The chitinous teeth in the stomach; besides these there is, at the spot where it joins the alimentary canal, a thick chitinous skin strongly corrugated, that appears almost as if it were hairy. In the alimentary canal I found only mud." From *Pentacheles euthrix*. From a drawing and notes by Willemoes-Suhm.

FIG. 18.—"Mandible with palpus, magnified about ×4," from *Pentacheles euthrix*. From a drawing by Willemoes-Suhm.

FIG. 17.—"Posterior portion of stomach with alimentary canal and telson," from *Pentacheles euthrix*, ×2. From a drawing by Willemoes-Suhm.

The contents of the stomach, as well as that which I found in the mouth of another specimen taken at a distant locality, were such materials as are found in the Globigerina ooze. That which I found in the stomach consisted of the remains of animals much crushed, while that taken from the mouth consisted chiefly of unbroken *Globigerinæ*.

The siagones or mandibles (Pl. XX. *d.d*) overlie the entrance to the mouth, and consist of two large concavo-convex blades, boldly serrate at the impinging margins; these two psalisiform blades meet in the median line and overlap each other like scissors. The

serrate margin is divided into three portions defined by a tooth that is larger and more powerful than the rest, each portion looking in a different direction, as shown in the figure (Pl. XVIII. *d*). In many Crustacea, perhaps in most, a massive tuberculated ridge or molar process traverses the base from the posterior to the anterior margin. In this family this process is smooth, and consists of a slender ridge, with the anterior extremity of which a two-jointed synaphipod articulates, the second joint of which is fringed with long hairs and generally lies folded in the hollow formed by the concave psalisiform blades, where it evidently acts as a brush to arrange the food in position during the process of manducation. The whole of this important structure is attached to a long apophysis or lever that is moved on its longitudinal axis by a muscle attached to a tendon just below the base of the psalisiform plate, and diagonally by muscles at the extremity of the apophysis, which are attached to the antero-lateral extremity of the carapace.

There is very little variation in the form of the mandibles in the various species or genera, and what little there is exists in the serrate margin, which may be more or less coarsely or finely marked, so that the number of denticles in the central division may vary in number.

The first pair of siagnopoda or maxillæ (Pl. XVIII. *e*) consists of two small, longitudinally curved plates, as shown in the accompanying cut, that lie laterally outside the siagnos, but are pressed firmly against its posterior surface. Both the plates are flat, and the outer one is the larger, and terminates in one or two strong spines. At the base of the outer plate is a compact tuft of ciliated hairs. This fasciculus likewise exists attached to the first pair of siagnopoda in the Scyllaridæ, to which the whole appendage bears a greater resemblance than to that of any other of the Macrura; it is very unlike the same in the Astacidæ. There is very little variation of this part in the various species, and what differences there may be appear to lie in a tendency for the outer branch to change in its relative proportion to the size of the inner.

FIG. 19.—First maxilla, × 3, of *Pentacheles euthrix*. From a drawing by Willemoes-Suhm.

The second pair of siagnopoda or maxillæ (Pl. XVIII. *f*) consists of two small plates, almost rudimentary in character, and a large squamose plate that is projected forwards as far as the anterior extremity of the mouth. The margin of the plate is fringed with short cilia, all directed towards the anterior extremity. The two small plates that are the rudiments of the normally formed appendage are tipped with long hairs, and are folded back against the great squamose plate. The second is implanted outside, and but little behind the first pair, and forms an efficient valve or doorway capable of shutting up the exit passage from the branchial chamber, so that while the animal might safely burrow in the mud, pure water could be retained in the branchial chamber, and irritating detrital matter

FIG. 20.—Second maxilla, × 3. From a drawing by Willemoes-Suhm.

excluded. This valve is a thick and strong appendage, and seems to vary but little. The variation that does take place appears to be in the form of the mastigobranchiæ, or the posterior extremity of the great squamose plate; and in the smaller of the two branches, which in some species, as in *Stereomastis suhmi*, is short and pointed. The large branch is generally folded longitudinally on itself. This appendage, except in possessing a strong mastigobranchia, a part common to most forms of Crustacea, varies considerably from the corresponding member in the Scyllaridæ, and also in the Astacidæ, but approximates to that in Palinuridæ.

The third pair of siagnopoda (maxillipedes) (Pl. XVIII. *g*) appears to be an important pair, if we may judge by its relative proportion. It is situated behind the mouth, on one side of the median line, and reaches back into the branchial chamber as far as to the extremity of the anterior branchial plume, and anteriorly beyond the oral apparatus, so that its extremity is visible in advance of the frontal margin of the cephalon. It consists of several branches, flat and leaf-like in character, which are so differentiated from the typical form in Crustacea, that it is only by an analytical comparison that the several parts can be homologically determined. The chief or primary branch is of great tenuity, and is folded to form a spoon-like hollow, with its convex surface turned inwards. This siagnopod is implanted immediately behind the mandibles, having the anterior pair outside rather than anterior to it. The cup-like hollow, which is formed by the leaf being longitudinally folded on itself, is turned outwards, and its inner or deeper angle, being that which is nearest the body of the animal, is subapical to the anterior extremity; thus a freely articulating plate plays in the cavity with probably a more or less constant voluntary vibration. This vibrating plate keeps the water circulating within the branchial chamber; while the mastigobranchial plate, which is very long and broad, and generally free from hairs, overlies that of the second pair, and assists it not only in its function, but, by permitting a free space between them, allows the water that may have been confined within the branchial chamber to pass out with more or less rapidity.

Fig. 21.—Maxillipede of *Pentacheles euthrix*, ×3. From a drawing by Willemoes-Suhm.

These are the several appendages that belong to the cephalon or head. They are much compressed together, inasmuch as there is none in a direct line between the metastoma and the third pair of siagnopoda. The first and second being situated laterally and but slightly posterior to the mandible.

The first pair of gnathopoda (Pl. XVIII. *h*) shows an approach to the pediform character. It is flat, broad, and covered with hairs, and varies very little in the several species. In *Pentacheles euthrix* the basis is serrate on the inner margin, while in most forms it is smooth on that part. In *Pentacheles euthrix* also there is attached to the outer and upper angle of the coxa a small projecting process that I take to represent the

rudiment of a mastigobranchia. I have seen nothing of the kind in any other species, and there is no ecphysis or branch attached to any other part of the appendage, a circumstance that is characteristic of few Crustacea, and distinguishes the species of this family from those of other related families.

Fig. 22.—First gnathopod of *Pentacheles euthrix*; at the base a rudimentary palpus. From a drawing and note by Willemoes-Suhm.

Fig. 23.—Second gnathopod of *Pentacheles euthrix*; at the base a rudimentary palpus. From a drawing by Willemoes-Suhm.

The second pair of gnathopoda (Pl. XVIII. *i*) is likewise devoid of an ecphysis attached to any of its joints, except the mastigobranchia, which is always small, and sometimes rudimentary. This limb is also pediform, more decidedly so than the first; it is much longer and more slender, it terminates in a sharp unguis, and overlies the oral appendages. In *Willemœsia leptodactyla*, *Pentacheles lævis*, *Pentacheles gracilis*, and *Polycheles crucifera* the mastigobranchia exists as a decided feature, capable of fulfilling its duty. In *Pentacheles euthrix*, as shown in Suhm's fig. 23, it is scarcely more than rudimentary, while in *Stereomastis auriculata*, *Stereomastis suhmi*, and *Polycheles baccata*, it is reduced to an absolutely rudimentary condition. It varies a little in shape, and in some it is studded with hairs.

The pereiopoda, with the exception of the posterior pair in the male of *Polycheles*, are all more or less chelate, and have little tendency to vary. The first pair (Pl. XVIII. *k*) is very long, being generally equal to the length of the entire animal. In *Polycheles crucifera*, however, it is not quite so long, a circumstance due to the shape of the carpos, which is short and broad, and approximates to the more common type in Crustacea, whereas in this family it is generally very long and slender—a character common to all the joints to a greater or less extent, and is especially marked in the dactylos and its antagonising pollex. The latter in the genus *Willemœsia* is armed with a strong and sharp tooth, which is absent in all the other genera.

The inner or impinging surfaces in the great chela are furnished with a sharp margin, peculiar in being formed by a series of microscopically small plates (k''''), placed erect and obliquely transverse. This structure, with some slight modification, appears to be common to all the species. The coxa generally carries a mastigobranchia and a podobranchial plume, that vary in their importance and in relative proportion. In *Polycheles baccata* and *Pentacheles euthrix* the mastigobranchia is small and of great tenuity. In *Stereo-*

mastis suhmi it is altogether wanting, and the podobranchia is reduced to an almost rudimentary condition.

The second pair of pereiopoda is much shorter, and assumes more the form usual in a chelate appendage, the fingers being slender and apparently more perfectly adapted for secure prehension. It is probably with this pair of appendages that the animal usually feeds itself.

The two succeeding pairs (Pl. XX. *m*) are also always chelate, but the fingers are long and tapering, and are generally both curved in the same parallel direction posteriorly, a circumstance that gives them a very feeble appearance.

The fifth pair is shorter than the rest, and varies from the simple styliform condition to that of a small and perfect chela, varying sometimes with the sex and sometimes existing as a specific character.

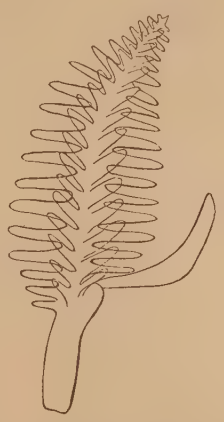

Fig. 24.—The lower and larger branchial plume of the first pair of pereiopoda, with flagelliform appendage of *Pentacheles euthrix*. From note and drawing by Willemoes-Suhm.

In *Polycheles* the male has this pair of appendages simple, but in the female it has not been determined in any species except *Polycheles baccata*, where it is chelate, but stunted and imperfect in form. The female of *Polycheles crucifera* is not known; while that of *Polycheles helleri* is unfortunately injured, so that the termination of the appendage cannot be made out. Professor Camil Heller says that he only knew of a male specimen of *Polycheles typhlops*, and the specimens taken during the cruise of the "Porcupine" have not yet been determined in their specific relation to each other.[1]

In the genus *Pentacheles* the posterior pair of pereiopoda is chelate in both sexes, and in most species the fingers are of unequal length. They are more nearly equal in *Pentacheles euthrix* than in any other; but in those species in which both sexes have been determined, as *Stereomastis auriculata* and *Stereomastis suhmi*, the female has the fingers as unequally developed, or nearly so, as the male; and it is because of this feature that I have arranged the species *gracilis* and *obscura* under the genus *Pentacheles* rather than under *Polycheles*.

The branchial arrangement (Pl. XX. fig. 1) is based on the same type throughout, and consists of sixteen branchial plumes on each side, with or without mastigobranchial plates of more or less importance, being large in *Willemœsia* and wanting in *Stereomastis suhmi* and *Stereomastis auriculata* in all the pereiopoda, and reduced to a small or rudimentary condition on the second gnathopoda, and absent from the first in all excepting *Pentacheles euthrix*, where it is only imperfectly represented; while it is developed into large plates on the two posterior siagnopoda.

The podobranchial plumes are generally large and well developed, except in the first

[1] In his Remarks on the Recent Eryontidæ, the Rev. Dr. Norman (*Ann. and Mag. Nat. Hist.*, ser. 5, vol. iv. p. 176, 1879) states that of the two specimens taken by H.M.S. "Porcupine" the female differs from the male in having "on front margin a pair of central spines (instead of a single spine)," besides indicating other differences that appear to be more than sexual characters.

pair of pereiopoda, where they are usually small and sometimes rudimentary. They exist attached to all the pereiopoda except the posterior, and are four in number. The arthropoda are similarly persistent, those attached to the anterior appendages being less developed than those situated posteriorly. There are eight in all—four anterior and four posterior plumes. There are also four pleurobranchiæ, but these are implanted between the somites above the four posterior pereiopoda, the last being the only plume connected with the posterior pair of pereiopoda. There are none above the first pair.

The branchial arrangement therefore differs from that of the Scyllaridæ, Palinuridæ, or Astacidæ.

In the posterior division or pleon the several appendages have a tendency to vary but little, but that little appears to be fixed and reliable. The most conspicuous and convenient feature for observation exists in the arrangement of the large dorsal median elevation. In *Polycheles crucifera* every somite except the first and last has two large teeth, one before the other.

In *Stereomastis suhmi* there are also two, but the posterior is much smaller than the anterior. In *Pentacheles obscura* there are also two on each somite, but these take the form of tubercles rather than teeth. In *Pentacheles auriculata* the teeth on the third and fourth somites are very long and slender; in most of the others they are more regular, but vary in number and proportion. Throughout all the species they are invariably directed forwards, a feature that is rare in other forms, and is suggestive of the idea that the animal normally creeps backward.

The first pair of pleopoda (Pl. XIV. fig. 1 *p*, ♀) is small, slender, and feeble in the female; in the male (fig. 2 *p*, ♂) it is large, strong, and well developed, evidently adapted for a sexual purpose. It is spatuliform and slightly curved, with the convex part towards the ventral surface of the pereion. The broad and curved blade lies anterior to the coxa or first joint of the posterior pair of legs (Pl. XIX. *p* ♂, *o*), so that the vas deferens, when projecting as it is capable of doing to a considerable extent (Pl. XV. fig. 3 *o*, ♂), falls upon the concave surface of the spoon-like pleopod, and is evidently held by it and directed against the ventral surface of the female, where its extremity rests in contact with or near the vulvar opening. That it does not enter the passage of this latter organ may be assumed from the circumstance that the foramen through which the vas deferens projects on the fifth pair of legs is much larger than that of the female on the third pair. We may therefore assume that the first pair of pleopoda conducts the extended vas deferens to its position and holds it there. This pleopod is the incipient representative of that organ which we see in the Brachyura, holding the vas deferens in an enclosed tube, and fulfilling the office of an intromittent organ.

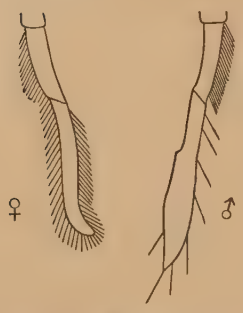

Fig. 25.—First pair of pleopoda, male and female, ×4, of *Pentacheles euthrix*. From a drawing by Willemoes-Suhm.

The four succeeding pairs of pleopoda are biramose and resemble each other, differing in the male and female in having the first pair furnished with two stylamblydes on the inner margin of the inner branch in the male, and with one in the female, as in all the other pairs. Under a low magnifying power of the microscope the extremity of a stylamblys in either sex, with but few exceptions, is furnished with small, blunt, hook-like points, which Sars has named cincinnuli. They are mostly rudimentary in this group of animals; but in others, as we shall show in the Penæidæ, they efficiently fulfil an important office.

The sixth pair of pleopoda is broad, large, and powerful, and goes to form the outer plates of the rhipidura or tail-fan, which in these animals is a powerful and much used appendage, of which the telson forms the central part.

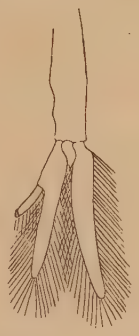

Fig. 26.—Third pair of pleopoda of *Pentacheles euthrix* ♀. From a drawing by Willemoes-Suhm.

Fig. 27.—Terminal portion of the Stylamblys.

The relation that this animal bears to other forms of recent Crustacea shows that, in its structure and in the depressed character, it lies near the genus *Arctus* of the Scyllaridæ, the chief distinctions being in the form of the second pair of antennæ, and in the direction of the antero-lateral angle of the carapace, which is thrown forwards instead of outwards. After this all resemblance appears to cease; for, with the exception of a modified resemblance of the first and second pairs of the oral appendages (siagnopoda), every appendage essentially differs.

There is an animal which has been alluded to in the present Report (p. 88) under the name of *Synaxes hybridica*,[1] that has much the character of a genus of the Scyllaridæ, but it possesses a long flagellum attached to the second pair of antennæ, which are large powerful organs without any scaphocerite, and are situated beneath the eyes, as in *Polycheles*; but the first pair, instead of being pressed close together as in that species, are forced down to a line horizontally lower than the second pair. The eyes are small but efficiently developed, and are situated in an orbit less perfectly formed than that of any of the Scyllaridæ, and more like that which exists in *Polycheles*, &c.; and is formed, as in that genus, by the anterior projection of the antennal angle of the carapace. All the other features of the animal—the pereiopoda, pleopoda, rhipidura, &c.—resemble those of *Arctus*, except that in the female the fifth pair of pereiopoda is simple in form, whereas in *Arctus*, and in the Scyllaridæ generally, it is chelate.

A near and interesting connection with *Synaxes* is to be found in the fossil described by Münster,[2] and reproduced by Woodward in his Chart of Fossil Crustacea, under the name of *Cancrinus clavigei*, from the Upper White Jurassic Limestone of Bavaria.

[1] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. vii. p. 221, pl. xiv.

[2] Münster, pt. ii. t. 15, fig. 1.

The figure of the fossil specimen demonstrates that the form of the pereionic appendages bears a strong generic resemblance to *Synaxes*. I have not had an opportunity of examining any specimens, and gain my impressions of this genus from the published engravings. The first pair of antennæ has evidently been forced below the second pair, which is reduced in length and enlarged in diameter; the flagellum being short, broad, and multiarticulate, is suggestive of a gradual approximation to the form as it exists in the Scyllaridæ. The structure of the animal has yet, however, to be more thoroughly examined in detail before its true relation to recent Crustacea can be satisfactorily pronounced. In some of the earlier figures of *Polycheles*, the animal was represented as being blind and having a laterally compressed rostrum, but the eyes have since been demonstrated, and the supposed rostrum has been shown to be the result of inner margins of the first pair of antennæ being extended and forced upwards by lateral compression, and thus simulating the form of a narrow rostrum. Dr. Camil Heller, who has the privilege of being the earliest observer who described and figured *Polycheles*,[1] considers that in the general form of the body it "bears a strong resemblance to the Scyllaridæ, from which it differs essentially in the structure of the antennæ and the form of the chelæ; and corresponds with the Astacidæ only in the common possession of the "leaf-like appendage (scaphocerite) at the base of the second antennæ, and in the chelate character of the pereiopoda, but differs in all other respects."

Polycheles, he further says, "corresponds closely with the fossil Crustacean described by Desmarest, from the slate quarries of Solenhofen (*Eryon cuvieri*), since also in this are found a flattened carapace, and similarly-formed antennæ and pereiopoda. The hinder part of the body is much narrower than the anterior; and the leaf-like appendages" (scaphocerite) "of the second pair of antennæ are much enlarged. It forms a link between the Scyllaridæ on the one side and the Astacidæ on the other."

Dr. v. Willemoes-Suhm[2] says:—"Among the living Decapoda Macrura there is hardly a group with which *Willemœsia* could be said to be very closely allied. Nearest to it are undoubtedly the Scyllarinæ; but these, like all the genera of the family Palinuridæ, differ from it in the absence of the lamellar appendage of the second antennæ, and in the presence of palpi at the base of the gnathopoda, which, as we have seen, are wanting in this new genus. Nor can it, for this latter reason, be referred to the Astacidæ, with which it has in common the presence of the antennal scale."

"It is very astonishing, indeed, that among all crustaceans known to us, *Willemœsia approaches most closely the fossil Eyrontidæ*. If we compare, for example, our figure of *W.* [*Polycheles*] *crucifera*[3] with a figure of *Eryon arctiformis*, and the description "Tribu des Eryons," given by Milne-Edwards[4] (and probably taken especially from Desmarest's 'Crustacés Fossiles'), we find most striking resemblances between the

[1] Crustaceen des südlichen Europa, 1863, p. 209, pl. vii. fig. 1.
[2] *Trans. Linn. Soc. Lond.*, vol. i. p. 55, 1875.
[3] *Trans. Linn. Soc. Lond.* vol. i. pl. xii. fig. 10.
[4] Hist. Nat. des Crust., tome ii. p. 278, Paris, 1837.

two forms. In *W.* [*Polycheles*] *crucifera*, as well as in *Eryon* the carapace has nearly half the length of the whole body and in both forms its lateral borders are wing-like expansions which are divided by two deep incisions into three portions. The anterior border of the carapace is nearly straight in both forms."

"*Eryon* was probably not blind; for the eye-stalks have been found in several specimens. Its antennæ seem to be somewhat more reduced than in *Willemœsia;* but the second pair of them has, according to Desmarest, 'une écaille assez large, ovoïde et fortement échancrée.' This is the chief difference between *Eryon* and the Palinuridæ, and the same in which *Willemœsia* also differs from that group."

"Milne-Edwards says nothing on the parts of the mouth; but according to Quenstedt they had a very large mandibula, one of the teeth of which was pre-eminently strong. This is very much like what we find in *Willemœsia;* but in the fossil genus palpi were present at the base of the first and second gnathopods, which are wanting in the living genus. The first pair of pereiopoda is in both forms longer than the following ones, and terminated by a pair of long and slender chelæ. In *Eryon* three pairs of pereiopoda, in *W. leptodactyla* five, and in *W. crucifera* four are terminated by chelæ. The form of the last pereiopod in *E. arctiformis* is exactly the same as in *W. crucifera;* and the abdomen [pleon] of these two forms is, as the above-mentioned figures show, so very much alike in the two forms, that, if the last pair of pereiopoda and the pleon of *Eryon* were presented to me without my knowing to what they belonged, I should undoubtedly declare them to be parts of the genus *Willemœsia.* There are the same line of spines at the top of the rings, the same wing-like expansions on both sides, and that characteristic 'nageoire caudale, dont la lame médiane est pointue et les quatres lames latérales moins longues que la médiane et hastiformes.' Also the fine fringe of hairs which distinguishes the caudal fin of *Willemœsia* is to be seen in the fossil crustacean."

"*Eryon* differs from the living genus chiefly by the presence of eye-stalks and of palpi at the base of the gnathopoda. According to Quenstedt the latter were observed only with some difficulty; and their presence seems not to be beyond all doubt. I shall only on my return be able to look myself over the original specimens and papers, and then, I hope, be able to give a more detailed account on the relations of *Willemœsia* to *Eryon.*"

But that anticipation, unhappily, was never fulfilled. Dr. v. Willemoes-Suhm, the talented naturalist of the Challenger, died on his way home; hence I thought it my duty to quote his remarks in full.

The fossil genus *Eryon*, from the lithographic limestone quarries of Bavaria, and from the Lias of England, has long been known to geologists. According to Desmarest it was first figured by Knorr and Walch in 1775, and named *Locusta marina* by Bajer in 1757. Schlotheim described it in 1820 under the name of *Cancer macrourites arcti-*

formis, and that of *Astacus* was given by Richter. It has also been figured by Desmarest under the name of *Eryon cuvieri*, in his Crustacés Fossiles, and the figure was afterwards reproduced in his Considérations des Crustacés. Since that Count Münster, as well as Mr. Woodward, has described and published the figures of several species, in a monograph on the Merostomata.[1]

The general resemblance in form of the species belonging to the genus *Eryon* to *Polycheles crucifera* is very close, both in the dorsal aspect of the carapace and in the character and arrangement of the pereiopoda. The pleon also with its terminal rhipidura bears a closely corresponding relationship.

An analytical examination of the several parts of the recent form demonstrates a variation in structure of a very decided and distinguishing character, when compared with the Solenhofen specimens.

Except in the recent forms related to *Polycheles*, the eyes are so impoverished as to be overlooked except on close examination, and then they are observed to pass beneath the outer or frontal angle of the carapace as in the annexed woodcut (fig. 28).

If we turn to *Eryon*, the appendage that is supposed to be the foot-stalk of the eye is situated at the extremity of a prominence projecting from the frontal margin of the carapace external to the antennæ. This is so constant among the specimens that, abnormal as it may appear, we must accept it as being a feature in the structure of at least one genus of the group. The outer or antennal angle is, therefore, not produced anteriorly as in *Polycheles*, or externally as in *Ibaccus* and *Arctus*, but recedes posteriorly from the orbit.

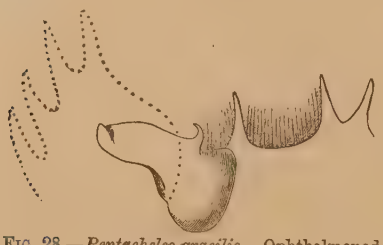

Fig. 28.—*Pentacheles gracilis*. Ophthalmopod and frontal margin of carapace.

The first pair of antennæ in *Eryon* has three cylindrical joints terminating in two flagella, not so short as in the Scyllaridæ, but very much shorter than in *Polycheles*. In this latter form the first joint of the peduncle of this antenna is developed on the inner side into a broad thin plate that is forced upwards by lateral pressure, while in *Eryon* the joint is simply subcylindrical.

The second pair of antennæ is robust, and, according to Desmarest, with a large scale at the base, which is not shown in his figure, but is understood by naturalists to mean the scaphocerite.

An examination of the specimens in the British Museum, which were courteously placed at my disposal by Dr. Woodward, F.R.S., has convinced me that "une écaille assez large, ovoïde et fortement échancrée du coté interne" does not always mean the scaphocerite, but sometimes refers to a squamiform extension in the breadth of the penultimate joint of the peduncle. This is well seen in *Eryon latus*, Münster (No. 44818 in the

[1] *Trans. Palæont. Soc.*, 1866; and *Quart. Journ. Geol. Soc.*, vol. xxii. p. 494, 1866.

British Museum Collection), as well as in other specimens less distinctly pronounced. In an unnamed specimen (No. 44930) this squamose enlargement exists on the preceding as well as on the penultimate joint, especially on the inner side. In some species it is not present at all, the penultimate joint of the peduncle being subcylindrical, but I have not seen any species among the numerous specimens in the British Museum Collection in which the scaphocerite can authoritatively be pronounced to be present, except in *Eryon speciosus* (Münster) (No. 44808), where it appears to exist on each side; but the condition of the specimen is fragmentary.

The oral appendages, so far as my own observations go, have not been made out; but Dr. v. Willemoes-Suhm quotes Quenstedt as having stated that *Eryon* had a very large mandible, one of the teeth of which was preeminently strong, and that the palpi were present at the base of the first and second gnathopoda. They are reduced but not wanting in *Polycheles* and its allies, but are homologous not with the basecphysis but with the mastigobranchia, originating as they do in the coxal joint. No other observer since Quenstedt has seen them in *Eryon;* we are not, however, justified in excluding his evidence until the specimens from which he obtained his information have been re-examined. The second and third siagnopoda are broad, foliaceous, of extreme tenuity, whereas the basecphyses, judging from what we know of other forms, are more or less long, narrow, and tapering, unless degraded to a rudimentary condition, when they retain a more or less distinctive rod-like character. Quenstedt could scarcely have mistaken them for any other parts, as the Rev. Dr. Norman suggests, if we are to assume any resemblance in their structure to those of other Crustacea.

The pereiopoda are extremely like those of *Polycheles crucifera.* The first pair is long, having the carpos short, the fingers of the chela long, slender, and overlapping at their extremities; the three succeeding pairs are short and chelate, with narrow propodos and slender fingers; the fifth pair is short, and not chelate, the dactylos being long and styliform.

One great anatomical distinction between *Polycheles* and *Eryon* appears to lie in the character of the ophthalmopoda, which occupy the same position in relation to the antennæ in both fossil and recent forms. In the recent genera, with the exception of *Eryoneicus,* the latero-anterior angle of the carapace is largely developed and overrides and covers a large portion of the peduncle of the eye, leaving only a deeply incised orbit that allows a portion only of the base to become visible on the dorsal surface. Even this is entirely obliterated in *Willemœsia.*

In *Eryon* the increased development of the antennal region of the carapace is wanting, consequently the organ of vision, instead of being covered and hidden from view, is exposed upon a peduncle, which in some species appears to be projected on a prominence.

If we examine the specimens from the Lias of England, we shall find that the latero-

frontal angle of the carapace is produced anteriorly to a considerable extent in some specimens, as for instance in *Eryon brodei* (Woodward), *Eryon wilmcotensis* (Woodward), and *Eryon barrovensis* (M'Coy), and in others, as *Eryon crassicheles* and *Eryon moorei* (Woodward) it is less so. Consequently, in those specimens in which the lateral angle is more developed, a depression corresponding to the orbit or orbital notch in *Polycheles* is present. Another feature in the British fossil specimens that distinguishes them from those of the Bavarian lithographic limestone, is the presence (according to Woodward) of a well-defined diæresis or line of division in the outer plate of the rhipidura.

This feature is common in *Astacus* and allied genera, but is not present in *Polycheles*, nor any of its congeners. Nor is it to be found in any of the Scyllaridæ or Palinuridæ. Among the Eryons I am only aware of its having been found in one species, and that is *Eryon barrovensis*, as restored by Mr. Woodward.

The eye is but rarely if ever preserved, and Woodward says "has never been positively determined," and the peduncle on which it is supposed to stand frequently appears as if it were biarticulated; but I have never seen a specimen or the figure of one in which the perfectly-formed eye has been found so as clearly to determine its form and character. In *Eryon brodei* the preserved orbit is moderately deep and the latero-anterior angle well advanced. It is the same, but rather less marked, in *Eryon wilmcotensis*, but in *Eryon moorei* and *Eryon crassicheles*, both orbital notch and antennal angle are reduced to a minimum value. All these are from the Lower Liassic rocks of England, except *Eryon moorei*, which is from the Upper White Lias of Ilminster.

The several species of *Eryon* appear to be distinguishable into separate genera, which are as definable from one another as they are distinct from the recent *Polycheles*, but the variability appears not to be greater in those that are separated in time through geological æons, than in those that are contemporaneous in geographical distribution.

While studying the fossil forms of the Eryonidæ in comparison with those recently brought to our knowledge through the deep-sea explorations, I have found in the collection of Mr. J. Edw. Lee of Torquay a specimen from the Lias of Lyme Regis, that appears to connect the two more intimately than has been shown in the comparison made with any previously known fossil specimen.

The specimen is fragile and imperfect. One half of the dorsal surface is tolerably well preserved, while the other exhibits only the impression of the form in the matrix. The two conditions are shown in the accompanying figure by a difference in the degree of shading, the darker being that of the external texture, the lighter where the impression of the form is alone retained, whereas the merely outlined portions exhibit the restoration of structure in conformation with known parts.

Archæastacus willemœsii,[1] the name by which I propose to call this fossil specimen

Fig. 29.—*Archæastacus willemœsii*, Sp. B., from the Lias of Lyme Regis.

has the dorsal surface of the carapace almost circular. The anterior or frontal margin being nearly straight between the orbital notches, while beyond them the lateral angles

[1] *Brit. Assoc. Report*, 1883; *Geol. Mag.*, dec. iii., vol. i. p. 307, pl. x., 1884. Beneath the plate in the Geological

are anteriorly produced beyond the frontal margin. The anterior and two-thirds of the lateral margins are smooth, whereas the posterior portion is armed with five prominent teeth. The median dorsal line is longitudinally armed with three or four prominent teeth, one being strongly marked on the frontal margin, a second imperfectly present over the gastric region, a third and fourth over the pyloric and cardiac regions, and evidence exists of a double row of bead-like tubercles longitudinally traversing the median line from the posterior to probably the anterior margin.

The inner line of the branchial region is posteriorly defined by a low ridge furnished with three or more small points or tubercles. From the gastric region to the lateral margins of the carapace, a strong ridge traverses the line of the cervical fossa in recent Crustacea, a circumstance that I believe is due to compression during fossilisation; the weaker parts yielding while the more rigid and stronger resist. Thus the fossa which is due to a reflexion or folding of the dermal tissue resists more decidedly the superincumbent pressure and remains rigid, while the surrounding structure yields. The cervical fossa, or as it may be called in this specimen, ridge, bifurcates into an anterior and a posterior branch, between the fork of which lies what Stimpson has called the hepatic region.

The posterior portion or pleon is broad, and symmetrically tuberculated; each somite generally carries, or is supposed to carry one large tooth or tubercle on the posterior margin in the median line, a similar but larger one near the lateral margin, centrally situated above the coxal plate, and another smaller in dimensions between this and the central, is situated on the posterior margin.

The animal appears to have no ophthalmopoda, although a semicircular notch in the frontal margin of the carapace seems to represent the orbit of the missing organ. This absence may, and I believe does arise from the soft and perishable nature of the eye when compared with the surrounding tissue, during the period of fossilisation, or it may be from the organ being hid, or reduced to a minimum condition as observed in the *Willemœsia*, or from its entire absence, as in *Eryoneicus*, but the presence of an orbital cavity determines that this ancient form has departed from a species in which the eye was an important feature.

Magazine, for the drawing of which the author is not responsible, a note and additions to the text were added by the editor after the paper had been seen by the author. A comparison of the figure in the magazine with that on pl. xxv. in the *Quarterly Journal of the Geological Society*, both of which were drawn under the superintendence of the editor of the Geological Magazine, will show that the form of the large chela and the ornamentation at the branchial margin of the carapace cannot belong to the same species. More than twenty species of *Eryon* have been described, but these are so various in their external form that it is difficult to imagine that they are not structurally, more than specifically distinct. As an example, Dr. Woodward, in a note to his Memoirs on the Species of the Genus Eryon (Desm.) from the Lias and Oolite of England and Bavaria (*loc. cit.*, p. 494), tells us that the diæresis "is absent in the outer caudal lamellæ of the Solonhofen species—a most important distinction: they differ also widely in form," and he describes all the English species as possessing it, "as in other Astacidæ." The diæresis is absent from the following recent families: Eryonidæ, Palinuridæ and Scyllaridæ, all of which belong to the Astacidea.

The first pair of antennæ has three short joints to the peduncle and the remains of a slender multiarticulate flagellum, to which I have given its probable length as well as a second branch, because I am not aware of any species of Macrura that has not a second flagellum attached to the first pair of antennæ.

The second pair of antennæ has very little of it represented in the specimen, but it evidently carried an ovate scaphocerite; that on the right side of our figure is half lost, whereas of that on the left there is the impression only; the rest of the organ is wanting on each side except what I take to be the impression of the distal joint of the peduncle, and the first articulus of the flagellum on the right side.

The first pair of large chelæ is well shown on the right side, although part of it is expressed by the impression only. That on the left I have restored in outline from that of a specimen of *Polycheles crucifera*, in order to show the near resemblance of the same part in the two genera.

All the other appendages are lost, or hidden beneath the body of the animal, excepting those that go to form the rhipidura, the outer plates of which are only determinable by the impression left on the rock. They are broad, leaf-like, and rounded at the extremity, without any sign of a diæresis or division in the outer plate, or a tooth at the outer distal angle; telson is broad at the base, and tapers abruptly to the extremity.

This species bears a generic resemblance to *Polycheles* of the recent seas, especially to *Polycheles crucifera*, in the form of the carapace, although it is deprived of its strong lateral armature, of which a trace only remains at the posterior branchial margin.

It bears, however, a nearer resemblance to *Polycheles helleri* and *Polycheles baccata* in the form and breadth of the pleon, but differs from all in the absence of a prominent longitudinal carina which is conspicuous in most of all the known recent species of the Eryonidæ, excepting the genus *Eryoneicus*, on the median dorsal surface of the pleon.

The fossil also differs from the recent species of the same family in having a broad and open orbital notch, instead of a narrow cleft in the dorsal surface of the carapace, which is filled up with the upper surface of the base of the rigidly attached ophthalmopod.

The first pair of antennæ, so far as I am able to interpret the evidence at my disposal, has not the inner margin of the first joint of the peduncle produced to an elevated ridge, a circumstance that is largely due to the distance at which these appendages are separated from each other.

The second pair of antennæ, if I understand correctly the parts represented in the specimen, approximates more nearly to the recent forms than to those of any fossil *Eryon* that I have met with, differing from the latter in carrying a distinct scaphocerite at the base. It is true Desmarest states that the second pair of antennæ is provided with a large scale, but he does not show it in his figure of the animal, and although it has been, I believe, generally accepted by authors who have written on the subject, I am not aware

of a specimen or figure excepting those that have been restored in which it has been determined.[1]

Taken as a whole, the specimen that I have here described resembles the form of the recent *Polycheles* as nearly as it does that of the type of the ancient *Eryon*. But in the breadth of the pleon and the absence of the dorsal carina, it exhibits a condition that demonstrates it to be no very distant departure from the genus *Astacus*, to which the great chela, notably in *Cambarus simulans*, Faxon, and *Cambarus clarkii*, Bajer, bears a near and characteristic resemblance, and the likeness would be more apparent if the animal, instead of being dorsally depressed, had, like *Astacus*, a more rounded or laterally compressed form.

It appears to me that the family of the Eryonidæ was a departure under deteriorating circumstances from some marine ancestor of *Astacus*, and that the recent genera are in direct descent from the *Archæastacus* of the European Lias.

The fossil genus *Palæocarabus*, from the Glasgow and Shropshire coal measures, appears to possess characteristic forms in the several genera of *Arctus*, *Polycheles*, and to be represented most closely by the recent genus *Synaxes*, from which it seems to differ chiefly in the laterally compressed rostrum, and it is interesting to notice that, separated as these genera are in time, as widely as the period when the coal-plants were living and growing in their native soil is from that of the present day, there is very little beyond specific distinction in character separating the oldest fossil from the most recent Macrurous Crustacea of the same family, and if we are, as is but reasonable, to judge of the alteration of parts unknown from the parts that are known, there is very little variation in structure also. So that in this group of animals whatever specific changes may have successively been produced, they are small in degree and unimportant in character; and therefore we may assume that the conditions of life on the globe, so far as relates to the present class of animals, can have undergone but little change.

Geographical Distribution.—The recent genera that belong to this family are widely distributed, but all of them appear to require certain conditions of depth, temperature, and character of sea bottom.

The genus *Polycheles* has been taken in the Mediterranean, and in the Atlantic off the coast of Spain;[2] in the West Indies, and in the longitude of the Fiji and Kermadec

[1] In the *Quart. Journ. Geol. Soc.*, vol. xxii. pl. xxv. fig. 1, Dr. Woodward delineated "by the help of the fine examples in the cabinet of the Rev. P. B. Brodie, F.G.S., and those in the British Museum," a completely restored figure of *Eryon barrovensis* (M'Coy) in which the scaphocerite is fixed at the extremity of a peduncle that is independent of that of the antennæ. This condition not being in accordance with the anatomical structure of the Macrurous Decapoda, I am induced to think that the small pedicular plate at the extremity of the third pair of maxillæ is intended, of which a drawing is given at fig. 31, p. 135, in this Report, and which in some recent species extends beyond the frontal margin. It may be seen on Pl. XIX. fig. C‴, which represents the under surface of the head in *Willemœsia leptodactyla*.

[2] Norman, On the Willemœsia group of Crustacea, *Ann. and Mag. Nat. Hist.*, ser. 5, vol. ii. p. 384, 1878.

Islands, at an average depth of 500 fathoms, on a muddy bottom, with a temperature approximating to 39°·5.

The genus *Pentacheles* appears to range as far as the limits of the great Pacific Ocean. Species have been taken among the Australasian Islands, the Philippine and New Guinea groups, near the middle of the ocean, about the Fiji and Kermadec groups, and along the south coast of South America, from Juan Fernandez to Cape Horn. Most of these were taken in the open ocean some distance from land, and generally on a muddy or oozy bottom formed of the débris of *Globigerina* and other Foraminifera. The depth at which they were taken varied from 120 to 1375 fathoms, but generally it was about 500. Belonging to exceptionally shallow water was *Stereomastis* (*Pentacheles*) *suhmi*, a species which, together with *Stereomastis* (*Pentacheles*) *auriculata*, I have been induced to separate from the other species and establish as an independent genus, in consequence of their having no mastigobranchial plates attached to the podobranchiæ (see p. 14). *Stereomastis suhmi* was captured within the narrow channels that separate the numerous rocky islets from the coast of Western Patagonia. The species from exceptionally deep water are *Pentacheles obscura*, a much damaged specimen taken north of New Guinea, in 1070 fathoms, and *Pentacheles lævis*, obtained off Juan Fernandez, at a depth of 1375 fathoms, but this latter species is represented by a second specimen taken south of the Philippine Islands, at a depth of only 500 fathoms. The temperature at the bottom varied from 35°·5 to 41°·8, according to the greater or less depth of the ocean, and the sea bottom, with one or two exceptions, is recorded as being formed either of mud or Globigerina ooze.

The general aspect of the animals, even when specifically distinct, bears a general close resemblance, and the alteration of the branchial apparatus appears to have no important influence on the external appearance. In *Pentacheles euthrix* the mastigobranchial plates are of extreme tenuity, and reduced in size, while they are absent in *Stereomastis auriculata* and *Stereomastis suhmi*. Yet the general character of their habits appears to correspond.

Willemœsia has been found in the middle of the North and South Atlantic Oceans. It was also taken in the Pacific, about 500 miles from the coast of South America, at a depth very nearly as great as that in the Atlantic, and at nearly similar temperatures, namely, 34°·6 and 35°·5 at a depth of 1375 and 2225 fathoms, as compared with a temperature of 36°·8 in the North, and 36°·4 in the South Atlantic Ocean, at 1900 fathoms. As in the preceding genera, the sea bottom where they were taken consisted of Globigerina ooze, a deposit sufficiently constant to induce us to believe that it is the common home of all the species of the genera that make up this group. The exceptions to these are few, only three, I believe, and these are in relation to *Pentacheles euthrix* and *Polycheles baccata*, which were taken on a rocky and red clay bottom.

Within certain limits it is therefore presumable that the family is represented by

species beyond certain depths, wherever a Globigerina bottom is to be found, a circumstance that is suggestive of the idea that in natural selection the character of the food is one of the most permanent influences in their geographical distribution.

Eryoneicus, Spence Bate.

Eryoneicus, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. x. p. 457, December 1882.

Carapace globose, dorsally hemispherical, nearly as broad as long: pleon narrow and folded beneath the pereion: rhipidura well-developed: telson as long as the lateral plates: ophthalmopoda absent.

First pair of antennæ having the first joint of the peduncle cylindrical, like the second and third, which terminates in two flagella.

The second pair of antennæ is scarcely longer than the first and carries a small scaphocerite and a long phymacerite.

The first pair of pereiopoda is long, and terminates in a narrow and slender chela; the second and following pairs are successively shorter and are chelate, except the last, which terminates in a short and simple dactylos.

Eryoneicus cæcus, Spence Bate (Pl. XIIe).

Eryoneicus cæcus, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. x. p. 457.

Carapace orbicular and circular, dorsally and laterally armed with numerous long, slender, spine-like teeth that appear to be symmetrically arranged on each side of the median line, the smaller being anterior and the larger posterior; the largest are situated near the postero-external angles of the carapace, the lateral walls of which are inflected on the ventral aspect from the frontal to the posterior margins.

The pleon is narrow, being about one-fifth the diameter of the carapace, and is similarly furnished dorsally as far as the extremity of the telson with long and slender spine-like teeth.

The ophthalmopoda are absent.

The first pair of antennæ has the flagella unequal.

The second pair is not much longer than the first; it carries a small scaphocerite and a long, straight, cylindrical phymacerite.

The second pair of gnathopoda is pediform, moderately long and slender.

The first pair of pereiopoda is smooth, long and slender, the chela being scarcely broader than the meros; the second pair is short, slender and armed with a few long spines; the third and fourth are shorter and furnished with a few corresponding hairs; the fifth is still shorter and terminates in a short and simple dactylos.

The anterior or first pair of pleopoda is wanting, and the others are biramose and foliaceous.

The rhipidura is symmetrical; both outer plates are fringed with ciliated hairs.

The telson terminates in a sharp point furnished with numerous ciliated hairs on each side, and with many long and slender spines on the dorsal surface.

Length, 13 mm. (0·5 in.), measured from the frontal margin to the extremity of the telson.

Habitat.—Station VII. v., off the Canary Islands, February 11, 1873; lat. 27° 58′ N., long. 17° 39′ W.; depth, 1620 fathoms; bottom, volcanic mud.

This unique specimen in general appearance is very unlike any other genus in the family.

The dorsal surface of the carapace, instead of being compressed, is elevated and has a globular appearance, while the lateral walls are bent under the ventral surface and lie flat in the same plane, apparently, with that of the sternum. It is dorsally covered with spines, or long, slender, sharp teeth, of which two stand longitudinally in the central line on the frontal region, and two on each side, one on each side of the gastric region and two on each side of the cardiac region, two on the upper and anterior portion of the branchial region, and several, which increase in length posteriorly, on the lateral angle formed by the sudden inflection of the carapace.

The pleon is very narrow and generally lies folded against the ventral surface of the pereion; it is dorsally armed with long and slender spines, one on each side of the median line and one on the lateral wall of the four posterior somites, just above the margin, which also is armed with a long posteriorly-directed tooth and two smaller ones, except in the case of the sixth somite, in which the margin is produced to a single, long and slender tooth: the telson is likewise armed with long and slender spine-like teeth, of which there is one in the median line near the base, and one on each side still nearer; these three are the largest, the others are smaller and ranged in rows on each side of the median line from the base to the extremity, which terminates in a small tooth on the dorsal surface, and is flanked with several ciliated hairs on each side.

The ophthalmopoda are absent, and no trace of organs of vision can be determined; there is a slight depression on each side near the central line of the frontal margin; and more laterally, beyond the outer antennæ, corresponding with the position of the eyes in *Willemœsia*, is a dark spot on each side that is suggestive of being an organ of vision, but the want of specimens for a close examination precludes me from being able to confirm the supposition.

The first pair of antennæ (*b*) has the first joint short and stout, armed on the inner side with a strong and sharp-pointed tooth that is broad at the base, and on the outer with a fine, anteriorly-directed, spine-like tooth; the second joint is very short but narrower than the first, and the third is yet shorter and narrower, and supports two unequal slender flagella that are not very long and only sparingly multiarticulate.

The second pair of antennæ (*c*) has the basal joint supporting a cylindrical rod that is longer than the peduncle of the antennæ; it is obliquely truncate at the extremity,

hollow, and contains a membranous canal; I think there can be no doubt that it is a peculiarly developed phymacerite; the second joint supports a long, straight-sided, foliaceous scaphocerite, tipped with a few hairs, but not armed with a tooth on the outer margin; the third or terminal joint of the peduncle is but little more important than the first joint of the flagellum, which is slender, tapering, sparingly multiarticulate, and about one-fourth longer than the longest of the first pair.

The mandibles and supporting oral appendages I have not examined, as, without destroying an interesting form, they could not be determined.

The second pair of gnathopoda is long, slender, seven-jointed and pediform, it terminates in a sharp-pointed dactylos, and is sparsely fringed with hairs.

The first pair of pereiopoda (*k*) is long and slender, and terminates in a slender chela that has the fingers longer than the palm, and impinging closely together throughout their entire length, and free from hairs or spines.

The second pair (*l*) is formed on the same type as the first, but is much shorter, being only half as long, and is adorned with long slender spines of which the two largest stand at the distal extremity of the carpos, and the others on the outer margin of the carpos and meros, and bears at the base a small appendage that I believe to be a basecphysis.

The third pair of pereiopoda (*m*) is little more than half the length of the second, but is rather more robust; it is chelate, but the fingers are short, with the pollex stouter than the dactylos.

The fourth pair (*n*) resembles the third, but is shorter and slighter, and like it, sparingly furnished with hairs.

The fifth pair (*o*) is short, robust, and simple, it is slightly shorter than the preceding, and terminates in a short, stout-pointed dactylos.

There is no appendage attached to the first somite of the pleon; but each of the four succeeding ones bears a pair of pleopoda that have two long, narrow, leaf-like branches fringed with hairs attached to a long and narrow peduncle; the inner plate carries a small cylindrical stylamblys.

The fifth pair, which helps to form the rhipidura, consists of two subequal, foliaceous plates fringed with hairs, and does not reach quite to the length of the telson.

Observations.—Dr. v. Willemoes-Suhm, who had the opportunity of examining this specimen when fresh from the sea, and from whose drawing the accompanying figure is taken, says, in his notes, that it is transparent, and that the alimentary canal, including the œsophagus and stomach, is of a bright red colour, while the hepatic lobes are yellow, represented by dots in the figure; the elongated tissue marked (*t*) is white; to this he appends the query, "Can it be a muscle?" which, from its position, I think there can be little doubt it is.

He also says that the dorsal spine-like teeth are arranged in longitudinal rows, one of which traverses the median line, the others running in pairs making a series of four. The posterior margin of the carapace is also similarly armed with teeth.

The pleon has similar spine-like teeth on each somite, both laterally and in the median line.

The telson is spinous, and has the terminal extremity beautifully fringed with hairs.

The branchiæ I have not been able to enumerate with certainty, but they exist rather in an impoverished than in a developing condition; the central stalk is long and robust, while the lateral filaments exist as globular papillæ, diminishing gradually from the base to the extremity, and are of less length than the diameter of the stalk to which they are attached.

The possibility has occurred to me of its being a young and immature form of some species allied to *Polycheles*, a hypothesis that was supported by the bottle containing it being labelled "Zoæa of Brachyura," but there are certain features that seem to be opposed to this supposition.

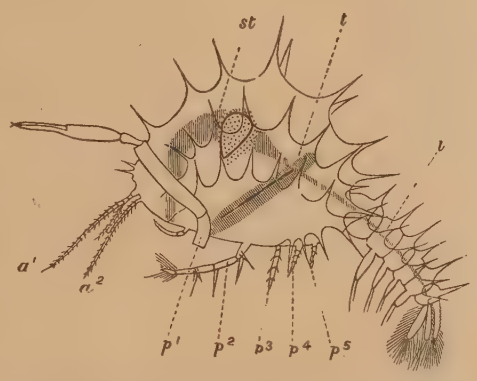

FIG. 30.—*Eryoneicus cæcus*. After a drawing by von Willemoes-Suhm. a^1, first antenna; a^2, second antenna; p^1, p^2, p^3, p^4, p^5, pereiopoda; *st*, stomach; *t*, testis (?); *i*, intestinal canal.

The brephalos of *Willemœsia* has not been observed, but I have been able to determine by examination of an embryo in an advanced condition (Pl. XX. fig. 2), that the ophthalmopoda at that period are well developed, and I have no doubt that when it quits the ovum the brephalos is in the megalopa stage, with the ophthalmopoda developed as in the young of *Astacus*. But the specimen that I have before me has no ophthalmopoda or trace of one. The frontal margin on each side of the median line, in the place where the ophthalmopoda are situated in the normal species of Astacidea, is slightly excavate, and this is suggestive of an orbital impression, but there is not the slightest trace of an organ of vision here, but on the outer side of the frontal margin, beyond the position of the antennæ, and corresponding with the ophthalmopoda in *Willemœsia*, is a dark circular spot that is suggestive of being such an organ, but without any structural indication of its function.

The first pair of antennæ differs from that in *Polycheles* and in *Willemœsia* in not having the inner margins, from the base to the distal extremity of the first joint, produced laterally so as to be brought into contact with each other and elevated upwards into a crest-like form, but only a large spine-like tooth at the inner distal angle.

The second pair of antennæ is peculiar, and, so far as I know, unique in character. The first or coxal joint carries a phymacerite, developed in the form of a long, straight, cylindrical tube that is obliquely truncate at the distal extremity. If we examine the same organ in *Willemœsia* we shall find it, though different in form, to be analogous in character, since it consists of a long cylindrical organ, but so curved that,

being directed upwards (Pl. XIX. fig. *c*, *ot*), the extremity of the organ rests against the under surface of the first joint of the first pair of antennæ (fig. C‴), producing a depression on the surface.

As I have previously stated, the desire not to injure this interesting and unique specimen has kept me from examining the oral appendages.

The second pair of gnathopoda and the succeeding pereiopoda closely resemble in proportion and general character the corresponding appendages in the genus *Pentacheles*.

The pleon differs in being considerably narrower than is generally the case in species of the Eryonidæ, of which, so far as I am aware, there are only two resembling it, namely, the recent *Polycheles rosea*, and the fossil *Eryon cuvieri*. It may, therefore, be considered that this form, whether immature or fully developed, adds another link to the connection between the recent and fossil Eryonidæ.

Polycheles, Heller.

Polycheles, Heller, Crustaceen des südlichen Europa, p. 209, 1863.
„ Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. ii. p. 276, 1878.

Dorsal surface of the carapace flattened and depressed. Latero-anterior angles projecting beyond the anterior margin. Pleon not longer than the carapace. Ophthalmopoda obscure, immovably lodged in an orbit excavated in the dorso-frontal margin of the carapace, more or less covered by the antero-lateral margin of the carapace.

First pair of antennæ furnished with two long slender flagella, of which the outer is the shorter.

Second pair of antennæ having a scaphocerite, and terminating in a long and slender flagellum; four anterior pairs of pereiopoda chelate, the anterior being the largest, and the fifth pair in the male terminating in a simple styliform dactylos.

First pair of pleopoda in the male having a long and slender biarticulate stalk, terminating in a broad and spoon-like extremity; in the female, biarticulate, slender and feeble throughout.

The second and four posterior pairs biramose, the branches fringed with long ciliated hairs, the inner branch, in the male, supporting two subequal stylamblydes, in the female, one.

The rhipidura is symmetrical and well developed, outer branch broad. Telson tapering.

Geographical Distribution.—This genus ranges from the Mediterranean to the West Indies. Heller's typical species, *Polycheles typhlops*, was first taken off the coast of Sicily, and by the Rev. Dr. Norman off the Portuguese coast, and *Polycheles sculptus*, S. Smith, was obtained in 250 fathoms off the coast of Nova Scotia; while other species are

recorded from the West Indies, the Fiji and the Celebes Islands, at depths varying from 220 to 1070 fathoms.

The Rev. Dr. Norman,[1] says that the females of *Polycheles typhlops* are characterised by the posterior pair of pereiopoda terminating in small and feeble but perfect chelæ, similar to those that exist in *Arctus*, *Ibaccus*, and most species of Palinuridæ. This is also the case in *Polycheles baccata*, but it does not appear to be persistent in every species, as may be seen in *Polycheles helleri*.

Polycheles crucifera (Willemoes-Suhm) (Pl. XIII.).

Willemœsia crucifera, Willemoes-Suhm, Trans. Linn. Soc. Lond., ser. 2, vol. i. p. 52, pl. xii. fig. 11; pl. xii. figs. 10, 11.
Willemœsia crucifera, Sp. B., Ann. and Mag. Nat. Hist., October 1878, p. 277.

Carapace ovate, lateral margins fringed with large teeth; frontal margin armed with a single rostriform tooth, and two sharp teeth on the inner angle of the orbital notch; dorsal median ridge without teeth, but minutely nodulated, as also is the dorsal surface, where lines of nodules correspond with the limits of the calcareous formation of the pereion. Pleon with a spinous carina traversing the median line, each somite being armed with two strong teeth. The eye is lodged in a narrow cleft of the dorsal surface of the carapace, and projects beneath the antero-lateral angle of the carapace, in the form of an obtuse point.

Length, 45 mm. (1·5 in.).

Habitat.—Station 23, off Sombrero Island, West Indies, March 15, 1873; lat. 18° 24′ N., long. 63° 28′ W.; depth, 450 fathoms; bottom, Pteropod ooze.

The dorsal surface of the carapace is marked with a cruciform line formed by a nodulated ridge that traverses the median line from the anterior to the posterior margin, and a transverse ridge along the posterior margin of the cervical furrow. Another nodular ridge on each side leads from the posterior extremity of the orbital notch to the cervical furrow, and another diagonally towards the lateral margins. Posterior to the cervical furrow the nodules are larger and more isolated; a row of these nodules, separated from each other, traverses the line of the internal margin of the branchial region, the others are more generally scattered, and the entire surface between the nodules is covered with a number of minute, rather stiff, curved hairs. The anterior division is a little narrower than the posterior, and is again, particularly at the margin, divided into two portions, each of which is armed with a series of long, slender, spinous teeth.

The rostral tooth in the median line of the anterior margin, instead of being horizontal, is nearly perpendicular to the dorsal surface, and is long and slender; on the

[1] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. iv. p. 177, 1879.

inner angle of the orbital notch are two small sharp teeth arising from nearly the same base, between which and the rostral tooth the anterior margin of the carapace is fringed with long hairs, as it is also between the outer angle of the orbit and the latero-anterior angle, which is directed obliquely forwards, curving outwards and upwards, the first division or antennal region thins out into a marginal ridge, which is surmounted by a series of six long outwardly and upwardly-curved teeth; the second division which is known as the hepatic region, is surmounted by five outwardly-directed and upwardly-curved teeth, of which the anterior is the most prominent. Posterior to the cervical suture the margin proceeds slightly outwards and then downwards, and is surmounted by a series of seventeen teeth directed outwards, upwards, and forwards, except those on the posterior margin, which are directed backwards and radiate in a curve corresponding with the rest. The posterior margin bends in a manner corresponding with the form of the animal, and supports a short curved spine near the articulation of the posterior margin of the carapace with the first somite of the pleon, between which and the median line on each side there are three or four small sharp teeth.

The first somite of the pleon is longitudinally short, narrower than the second, and supports one sharp tooth on the median line; it has no coxal plate, the outer extremity terminating in a nodular cusp that articulates with a corresponding cup in the carapace (peltecleis) and locks it in position.

The second somite is longitudinally longer than the first, and is bisected by a furrow on each side of the median line, the central crest of which carries two sharp teeth, placed one behind the other, the anterior of which is directed obliquely forwards, while the posterior is nearly perpendicular; the third, fourth, and fifth somites resemble the second except that each gradually narrows in succession, and the coxal plates become more pointed; the sixth somite has no dorsal teeth, but protuberances only: the telson is long and tapering, with two small longitudinal ridges on each side of the median line.

The ophthalmopoda (*a*) are small, obscure, and immovable, the upper portion is bulbous and fills a small notch or cleft in the anterior margin of the dorsal surface of the carapace, whence it narrows to a point and lies impacted in a hollow on the outer side of both antennæ (*b*, *c*), beneath the projecting antero-lateral angle of the carapace; a small tooth projects from the anterior surface of the upper or bulbous portion of the ophthalmopod. It is impossible in the present condition of the animal to state with certainty, but from the appearance of the organ I am inclined to believe that vision existed at two points, namely, at that part of the upper surface exposed within the orbital notch, and inferiorly at the extremity of the ophthalmopod. The animal, however, can have had only a very limited range of vision outwardly, by the aid of one lens above, and another below and a little in advance, and even this, from the apparent density of the cornea, must have been of a very imperfect character.

The first pair of antennæ (fig. c, *b*) has the first or coxal joint thick and bulbous on the

outer side, where it is armed with one slender sharp-pointed tooth, beyond which is a long, narrow, transverse slit or opening leading to the auditory chamber. On the inner side the margin thins out and curves upwards to a crest, and is fringed with four anteriorly-directed teeth, of which the posterior is the smallest and the anterior the largest; the second joint is shorter and narrower than the first, and the inner anterior angle is produced to a sharp tooth; the third joint is shorter and narrower than the second, and has also the inner anterior angle produced to a sharp tooth; the surfaces of these three joints are sparsely covered with short thick hairs: the inner flagellum is about as long again as the outer, it is more robust, and divided into numerous small articuli, each of which bears three or four small stiff hairs at every articulation.

The second pair of antennæ (fig. c, *c*) is situated on the outer side of and a little below the first pair; it consists of only four joints, the second and third being fused together: the first joint is closely impacted in the metope but not fused with it, and carries a long curved phymacerite that passes inwards and upwards, terminating in an obtuse extremity that is laterally flattened against a sub-membranous depression on the under side of the first joint of the first pair of antennæ; the second joint is diagonally fused with the third, which carries on its outer angle a short lanceolate scaphocerite, the extremity of which reaches beyond the penultimate joint of the peduncle; the fourth and fifth joints are cylindrical, and terminate on the inner distal angle in a small tooth: the flagellum is slender, and resembles in length and form the longer branch of the first pair of antennæ.

I did not dissect the oral appendages in this species, inasmuch as the specimen, which is a very beautiful one, is unique, and I expected to obtain similar observations from other species of which specimens were more numerous.

The second pair of gnathopoda (*i*) is six-jointed, the basis and ischium being apparently fused into one. The coxa is furnished with a short, curved, rigid mastigobranchia, sparsely fringed with hairs on the convex side; the basis is fused with the ischium, and carries no ecphysis; the ischium is long and robust; the meros also, but not so stout or so long as the ischium; the carpos is short and small; so also is the propodos, but longer than the carpos; and the dactylos is styliform and as long as the propodos; the inner and outer margins of all the joints are fringed with hairs.

The first pair of pereiopoda are much larger than the rest. The coxa is large, being broader in diameter than the basis, which is narrow and curved, so that the ischial articulation is directed outwards and slightly backwards; the ischium is round and small at the basisal articulation, and gradually enlarged and flattened towards the meros, with which it articulates; the meros is longitudinally arcuate, flattened, increases in breadth, and again narrows and thickens towards the carpal joint; the carpos is triangular, narrowest at the meral extremity, broadest at the propodal, and is armed with a small tooth at the inner distal angle; the propodos is long, broad, and flattened, widest just beyond the carpal extremity, where it bulges out to give insertion to the flexor muscle of

the dactylos; the outer margin is armed with several small teeth, of which the largest is at the anterior angle, the others irregularly lessening until they disappear near the middle. The pollex is long, slender, gradually narrowing to the apex, where it is pointed and curves to meet the dactylos: it stands at a slight angle with the propodos, and gradually curves upwards. The dactylos corresponds in form and length conversely with the pollex, against which it impinges when closed throughout the entire length by a series of small leaf-like plates closely impacted sideways against each other, the points being directed posteriorly. These fade away towards the extremities of the pollex and dactylos, which overlap each other when closed.

The second pair of pereiopoda is considerably smaller than the first, to which it otherwise bears a general resemblance, excepting that the propodos is much more slender, being not broader than the carpos, and has the margins fringed with long hairs.

The third and fourth pairs are also chelate, but differ from the preceding in having the curve of the dactylos in the opposite direction. The pollex is long and slender, and armed with a row of short spines on the posterior margin. The dactylos is longer than the pollex, smooth on both margins, except for a few delicate hairs near the base, and slightly curved posteriorly.

The fifth pair of pereiopoda (*o*) is shorter than the preceding, which is due to the three last joints being each slightly shorter than their homotypes in the preceding pairs, more especially the dactylos, which is thicker and shorter and sub-lanceolate, there being no polliciform prolongations to the propodos. This pair is simple in the male, the only sex with which we are acquainted.

The first pair of pleopoda (*p*) is biarticulate, the first joint being a three-sided stem, which, when pressed against the ventral surface, lies compactly in a curved groove formed between the ventral surface of the pereion and the projecting inferior margin of the carapace. This joint reaches as far as the coxa of the posterior pair of pereiopoda, where it articulates with the second, which is narrow at the base, and at a short distance from it suddenly widens into a long, hollow, spatuliform organ, the distal extremity of which reaches as far as the coxa of the third pair of pereiopoda. This form only exists in the male; and, from its position and relative proportions, it undoubtedly fulfils an effective purpose. But of this I shall be enabled to speak more fully when writing of another species which I have had better opportunities of examining.

The second pair of pleopoda (*q*) is biramose, the two branches being foliaceous, narrow, flattened, flexible, tapering, and fringed at the margin with fine hairs; the inner ramus near the base supports two stylamblydes of unequal length, the longer of which is furnished with two or three rather obscure cincinnuli.

The third, fourth, and fifth pairs of pleopoda resemble the second except in having only one stylamblys instead of two.

The sixth pair articulates with the posterior margin of the sixth somite of the pleon;

it aids the long and lanceolate telson in forming a well-developed rhipidura. The basal joint is short; while the rami are long, broad, foliaceous, and lanceolate, the margins being fringed with a row of closely-planted, evenly-set hairs.

Observations.—The specimen is the only one of this species taken. According to Dr v. Willemoes-Suhm, when obtained it "was red, which is I believe the prevailing colour of all deep-sea Crustacea." This colour, however, rapidly disappeared when the specimen had been for a certain time in spirit.

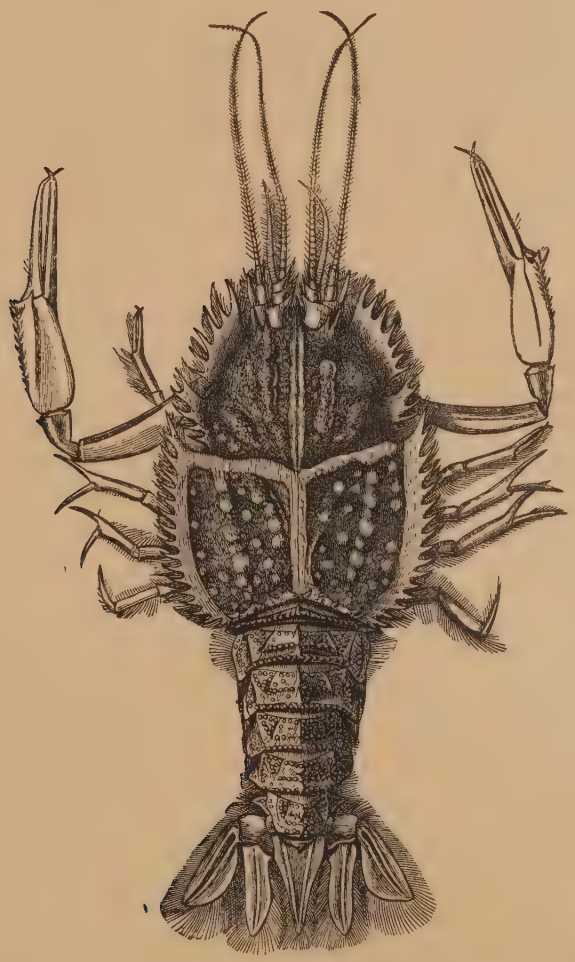

Fig. 31.—*Polycheles crucifera.* From a drawing by Dr. v. Willemoes-Suhm.

Polycheles baccata, Spence Bate (Pl. XIV. fig. 1).

Polycheles baccatus, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. ii. p. 278, 1878.

Carapace scarcely broader than the pleon at its anterior extremity, lateral margins subparallel, anterior division armed with twelve teeth, the median, which is but imper-

fectly separated from the anterior with five, and the posterior with twenty-five, more or less small teeth. The anterior frontal margin is furnished with one large and two small rostral teeth. Dorsal ridge without teeth or spines, but bead-like tubercles traverse the median line and the posterior margin of the carapace. Pleon carinated, the four anterior somites each projecting to an anteriorly-directed tooth. Ophthalmopoda lodged in a deep notch in the dorsal surface of the anterior margin of the carapace. Meros of the first pair of pereiopoda smooth except a small tooth on the outer distal angle, and two near the external distal angle of the carpos, and one small one on the inner. Fifth pair of pereiopoda terminating in the male in a long, slender, sharp, styliform dactylos, and in the female in a short and stunted chela (fig. 1 *o*, ♀).

The dorsal armature of the carapace may be thus formulated—

Marginal, ...	12—5—25
Rostral, ...	3 ... ...
Dorsal crest, ...	0 ... ...

Length—male, 80 mm. (3·3 in.); female, 85 mm. (3·6 in.).

Habitat.—Station 173, July 24, 1874; lat. 19° 9′ 35″ S., long. 179° 41′ 50″ E.; off Matuku; depth, 310 to 315 fathoms; bottom, coral mud.

The carapace is of a long quadrate form, the lateral margins being nearly parallel, slightly converging at each extremity, and adorned with a great number of small teeth. The anterior division has ten or twelve, but between them is a considerable quantity of small hairs that fill the intervening spaces, particularly in the younger animals. The central division has four or five similar teeth, and hairs, but their separation from the anterior is not always very perfectly defined. The posterior division is more distinctly separated, and carries about twenty-five or twenty-six teeth, not very clearly defined, which gradually diminish in size. The lateral wall of the carapace below the serrate margin is perpendicular for some distance, and then flattened inwards at almost right angles. The perpendicular portion is covered with long hairs, especially visible on the lower margin, where there is a row just above a line of very fine teeth that form a ridge between the vertical and the horizontal portion of the lateral wall of the carapace; the horizontal part is slightly granular, and between the granules the surface is perfectly smooth.

The anterior margin of the carapace (fig. 1 c) has the lateral angles projecting slightly in advance of the central or rostral point, which consists of a strong tooth arising from the metope, directed obliquely upwards and forwards, and flanked by two small teeth, one on each side behind on the frontal margin of the carapace, and a row of hairs, on the outer side of which a serrate margin passes outwards and forwards to a point, from which it recedes also as a serrate margin to the inner angle of the orbit, where a short and slender tooth projects. The outer angle of the orbit is also armed with a sharp and slender tooth, whence obliquely to the outer angle of the carapace are several small, sharp teeth.

The posterior margin is deeply excavated in the centre, from which the margin, fringed with a row of minute hairs, recedes posteriorly and outwardly on each side to a strong tubercle, the peltecleis, which overrides and articulates in a hollow or socket formed in the coxal plate of the first somite of the pleon. From this tubercle the posterior margin passes downwards and outwards, and becomes continuous with the lateral margin. From this point also an obscure line, slightly baccated in appearance, passes in a flexuous direction forwards on the dorsal surface of the carapace, corresponding with the internal wall of the branchial chamber.

The first somite of the pleon has the anterior division long and the posterior short; the former is smooth, and passes beneath the carapace, when the animal is extended; the latter is granulated, and is armed with a strong anteriorly-directed tooth in the median line, and extends laterally until it reaches the coxal plate, which is produced obliquely forwards, and overlaps the posterior margin of the carapace, external to the tuberculated process or peltecleis, and thus secures or bolts the carapace in position. The second somite is not longer than the first, but has the first or anterior division shorter and covered almost entirely by the previous somite when the animal is extended; the posterior division is longer, granulated, and divided transversely by a groove or furrow that runs obliquely from near the anterior margin at the median line to the postero-lateral margin, where it joins with the coxal plate. A large sharp anteriorly-directed tooth longitudinally traverses the posterior division in the median line; the coxal plate is extremely large, being produced forwards to an obtuse point beyond the margin of the carapace downwards and inwards, and rounded inferiorly and posteriorly in a continuous line; the upper portion of the surface is granulated, the lower smooth, and the margin fringed with long hairs. The third, fourth, and fifth somites resemble the second, excepting that they gradually narrow posteriorly, and the tooth on the dorsal median line becomes less important in the fourth, and only appears as a ridge or crest on the fifth somite, and also in the form of the coxal plates, which are not produced anteriorly, but have the anterior margin hollowed, uniting with the posterior margin so as to form an obtuse angle with it. The sixth somite is narrower and slightly longer than the preceding; the coxal plate is more pointed and posteriorly excavate, to admit of the articulation of the posterior pair of pleopoda; the dorsal median line instead of being armed with a vertical tooth is furnished with a double row of small bead-like tubercles. The telson is long, pointed, horizontally ribbed, and fringed with long hairs. There appears to be no feature in the dorsal structure that distinguishes the male from the female, which is slightly the larger in our specimens.

The ophthalmopoda (fig. 1c, *a*) are small, obscure, anteriorly armed with a small tooth, and lodged in an orbit excavated in the anterior margin of the carapace, compressed on the under side by the membranous articulation of the second pair of antennæ, and point outwards, covered by the projection of the latero-anterior angle of the carapace, and

protected by a mass of hair on the under and outer side of the orbit, as well as by a fringe of the same on the upper surface, that almost hides it from view, more especially in the female.

The first pair of antennæ (fig 1 c, *b*) has the first joint dorsally concave, the inner margin projecting upwards so as to form, with the corresponding inner margin on the opposite side, a crest, which is fringed with small teeth and long hairs, and produced forwards to a point; the second joint is small, narrow, and fringed with hairs on the inner and outer sides; the third is small, and similarly fringed with hairs, and carries at the extremity two flagella; the outer is more slender, and built up of numerous small bead-like articuli; the inner has the articuli longer and broader.

The second pair of antennæ (*c*), including the coxa, articulates with the metope, it carries a long projecting phymacerite, the extremity of which is flattened, turned upwards, fringed with hairs, and covered by a membranous tissue, which impinges against the lower surface of the coxa of the first pair of antennæ, where a hollow impression exists to receive it; the second joint carries at its outer distal extremity an obtusely-pointed scaphocerite fringed with long hairs, and on the inner a short, strong tooth; the next joint is narrower than the preceding, is thinner on the inner than the outer side, and fringed with a row of very long hairs, and is anteriorly produced to a short but strong tooth; the terminal joint is cylindrical, narrower, and shorter than the preceding, and is also fringed with long hairs; the flagellum is long and slender, and resembles the inner of the first pair.

The mandibles are large and powerful, and are deeply serrate along the incisive margin of the psalisiform blade, the centre of which is furnished with a strongly projecting pointed tooth, advanced considerably beyond the others, which gradually recede to the upper and lower extremities, which are also armed with a strong and pointed tooth; the mandibles carry a biarticulate synaphipod, which folds and lies within the hollow of each mandible.

The first pair of siagnopoda consists of a biramose uni-articulate appendage, flat, thin, rigid, and curved longitudinally, the extremities armed with long spines and hairs, lying closely against the metastoma or posterior lip, which consists on each side of a long and slender styliform membranous process, closely impacted diagonally against the mandibles.

The second pair of siagnopoda consists of a large foliaceous plate extending both anteriorly and posteriorly, and two small branches, one slender and pointed, the other flat and spatuliform, and folded back upon the larger plate. The two smaller have the edges smooth, but the largest is surrounded by a closely-set fringe of equally long hairs, and has the surface flecked with fine cilia, sparsely distributed.

The third pair of siagnopoda (fig. 32) is foliaceous and convolute; the upper extremity is constricted so as to form a chamber or pocket into which a triangular articulated joint

falls, being attached by one angle: the moveable plate does not close as an operculum, but is inserted marginally, and both chamber and plate are fringed with rather long, finely ciliated, thickly-set hairs. At the foot of the appendage is a broad, flat, curved plate, thinly fringed with long hairs. The anterior extremity of this siagnopod reaches forwards beyond the base of the antennæ; it passes beyond the mandibles, and it is through this channel that the water of expiration passes out of the branchial chamber, the moveable plate at the extremity being probably a valve which admits of its more or less rapid egress. I have not determined the exact form of the mastigobranchial plate in this appendage, as it was partially ruptured.

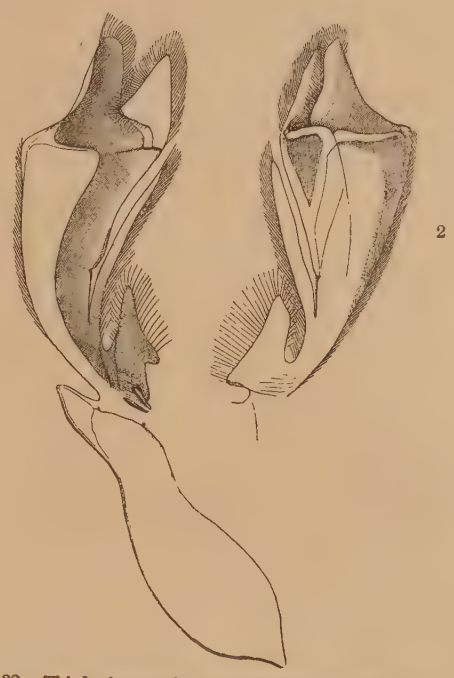

Fig. 32.—Third siagnopod, (maxillipede) of *Polycheles baccata*. 1 outer, 2 inner surface.

The first pair of gnathopoda is short, not reaching beyond the mandibles, and seven-jointed, but carries no ecphysis. The coxa is short, the basis is scarcely more important, and, without close observation, appears united with it; the ischium is short and cylindrical; the meros long, ovate, very slightly flexed, concave below; the carpos is transversely triangular, being broader at the propodal extremity than at the meral; the propodos is short, narrow and cylindrical, and the dactylos is reduced to a strong slightly curved spine; all the joints are fringed on the inner side with hairs, stiff and firm on the propodos and carpos, soft, yielding, and ciliated on the meros and ischium.

The second pair of gnathopoda is as long again as the first, and reaches forwards as far as the first joint of the antennæ. It is long and slender, and consists of six joints. The coxa is broad, and carries a rudimentary mastigobranchia, consisting of a minute sharp-pointed membranous plate, supporting a few short hairs; the basis and ischium are fused into one long joint, arched on the outer side and flattened on the inner, and longitudinally curved; the meros is long, and continues the arch of the previous joints; the carpos is cylindrical and short; the propodos is also cylindrical and short, but longer than the carpos; the dactylos is lanceolate and thickly fringed with hairs, as is the entire appendage, but more sparingly, with long ciliated hairs, mostly on the inner side.

The first pair of pereiopoda is as long as the animal, slender, flattened, and chelate.

The coxa is broad, the basis small and cylindrical; the ischium is long and flat, cylindrical at the basisal joint, and broad and flat at the meral; the meros is long and flat, straight on the inner margin and wavy on the outer, increasing in breadth from the ischial joint, from whence it again narrows, and then widens at the carpal, where it is armed with one small curved tooth; indications of teeth along the posterior margin are visible only under a lens; the carpos is cylindrical and narrow where it articulates with the meros, whence it increases in diameter gradually until it reaches the propodal articulation; the inner margin is straight and smooth, but armed with an inner and outer sharp cusp near the propodal joint; the outer margin is also straight, but not parallel, being divergent; it is grooved longitudinally, each side of the depression being minutely serrate, the upper ridge terminating anteriorly in two curved sharp teeth. The propodos is long, ovate, longer than the carpos, rounded on the under side, and armed with a double row of very small denticles, and straight on the upper, which is fringed with a number of small sharp teeth; the polliciform process is as long as the palm of the propodos; it is straight until close to the extremity, when the point suddenly thins and turns upwards; the dactylos is straight, long, and slender; it resembles the pollex reversed, the two meeting and impinging against each other on the inner margin throughout their entire length; each of them is armed with a series of closely packed, thin, obliquely and transversely placed plates, except at the long thin curved points which cross and pass each other.

The second pair of pereiopoda is short, being not more than one-third the length of the first pair; the joints are proportionately robust and less flattened; the carpos is armed at the outer anterior angle with a strong spine; the propodos is long and transversely triangular, with a ridge longitudinally traversing the outer surface, the inner being flattened; the pollex, instead of being in line with the propodos, is slightly bent inwards and downwards, a direction followed by the dactylos, the inner margins of which when closed, impinge against each other in their entire length, and are armed with a series of minute thin plates similar to those in the first pair, but somewhat more pointed; a few long hairs planted in rows on the margins give the limb a more hirsute character than the preceding.

The third pair of pereiopoda is smaller than the second, the joints are rather more slender, and the propodos is not larger in diameter than the carpos; the pollex and dactylos are long, slender, and slightly curved reversely, so that the dactylos, instead of being flexed towards the pollex, is turned from it, and the pollex is curved parallel with the dactylos.

The fourth pair of pereiopoda resembles the third very closely.

The fifth pair is still smaller and terminates in a styliform dactylos. The coxa of this pair of limbs in the male (fig. 1 ♂, *o*, *o*) is large, and is perforated by a foramen, through which the vas deferens protrudes. In the female the fifth pair of pereiopoda (fig. 1 *o*, ♀)

differs from that in the male in being imperfectly chelate instead of terminating in a simple styliform dactylos. The propodos is long, fringed with very long hairs on the internal margin, and terminates abruptly. It is only on close inspection that the dactylos is found to be present. The distal extremity of the propodos is produced to a blunt, internally hollowed pollex. The dactylos is not longer than the pollex, flat, double-pointed, blunt, and fringed with a few hairs.

The branchiæ are in accordance with others of the genus, and may be tabulated as follows :—

Pleurobranchiæ,	.	.	.	.	...	...	...	...	1	1	1	1
Arthrobranchiæ,	.	.	.	.	...	...	...	2	2	2	2	...
Podobranchiæ,	.	.	.	.	...	...	...	1	1	1	1	...
Mastigobranchiæ,	.	.	.	.	...	...	1	1	1	1	1	...
						h	i	k	l	m	n	o

The first pair of pleopoda in the male is two-jointed (fig. 1 ♂, *p.p.*); the basal joint is cylindrical, the next commences as a small stalk and suddenly expands into a broad thin spoon-like plate, the convex surface of which presses against the ventrum. They meet in the median line, the inner margin of one overlying that of the other to form a hollow groove, in which, I presume, the flexile extension of the membranous organ of the male animal is supported at certain periods.

In the female this same pair of pleopoda (fig. 1 *p*, ♀) is long, slender, compressed, and fringed with fine hairs.

The second pair of pleopoda (fig. 1 *q*, ♂) consists of a long, straight, basisal joint, that supports two flattened branches, to the inner margins of which, in the male, two rigid stylamblydes are attached. In the female (fig. 1 *q*, ♀) it resembles that of the male except that it carries a single stylamblys, as is the case in both sexes in the several succeeding pairs of pleopoda, except the sixth, which combines with the telson to make a broad and well-formed rhipidura.

Observations.—There were six specimens of this species taken about 100 miles south-east of the Fiji group of islands, associated with *Pentacheles euthrix* and *Benthesicymus*. Two were 80 mm. and 85 mm., and three from 37 mm. to 40 mm. in length. Of the larger, one is a male, the other a female. The above description has been drawn from the male or smaller of these two specimens. Of these smaller specimens the largest one is a male, characteristically though not fully developed; the two others are females. The vulva in each is apparent; the form of the first pair of pleopoda, as characteristic of the female, is distinguishable in each, and there is but a single stylamblys on the second pair of pleopoda. In connection with the smaller females, the posterior pair of pereiopoda terminates in a single styliform dactylos, a condition that is characteristic of the male. I am therefore induced to believe that the chelate structure in the female only exists in adult forms, or in those approaching maturity.

The branchiæ in this species are of the normal character, but there is no evidence of even a rudimentary mastigobranchial lash attached to the first pair of gnathopoda, as we see in *Pentacheles euthrix;* in the second pair it is in a more rudimentary condition than in that species. The mastigobranchiæ attached to the several pairs of pereiopoda are of great tenuity, and shorter than the podobranchiæ.

Polycheles helleri, Spence Bate (Pl. XIV. fig. 2; Pl. XV. fig. 1).

Polycheles helleri, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. ii. p. 276, 1878.
Pentacheles helleri, on pl. xv.

Carapace not broader than the first and second somites of the pleon, lateral margins subparallel, anterior division armed with seven teeth, median with four, and posterior with four or five well-developed teeth near the anterior extremity, from which they gradually decrease in size posteriorly; dorsal central ridge armed with two rostral teeth directed upwards on the anterior margin, which, with the series in the median line, may for convenience be formulated, commencing anteriorly, as 2–1–1–2–1, fossa 2–2–2.

The pleon (Pl. XIV. fig. 2P) is carinated on the five anterior somites, the anterior margin of the crest of each somite culminating in an anteriorly-directed point.

Habitat.—Station 170, near the Kermadec Islands, north of New Zealand, July 14, 1874; lat. 29° 55′ S., long. 178° 14′ W.; depth, 520 fathoms; bottom, volcanic mud; bottom temperature, 43°. One specimen.

Length, about 36 mm. (1·5 in.).

Station 218, north of New Guinea, March 1, 1875; lat. 2° 33′ S., long. 144° 4′ E.; depth, 1070 fathoms; bottom, blue mud; bottom temperature, 36°·4. One specimen.

Length, 50 mm. (2 in.).

This species is rather more slender than *Polycheles baccata*, and is readily distinguishable in having a double rostral tooth arising from the anterior margin of the carapace, and none from the metope between the first pair of antennæ; the anterior margin of the carapace is smooth and recedes gradually to the orbit, which forms a rather large notch in the dorsal surface of the carapace, and thence it advances obliquely outwards to a sharp tooth that forms the latero-anterior angle of the carapace. The lateral margin is furnished with six teeth on one side, and seven on the other in the anterior division; three on the median; on the posterior, or that portion of the margin of the carapace that lies behind the cervical fissure, there are two or three tolerably conspicuous teeth situated anteriorly, and so also near the posterior margin, but in the space between these two points, the teeth are only represented by small notches or are entirely wanting.

The median line of the carapace is armed with a series of distal teeth, on the anterior margin are two rostral teeth that stand obliquely upwards and forwards, behind which in

a line with the posterior margins of the orbits is a single sharp tooth; at an equal distance behind is a second, behind which, at a similar space, are two side by side, posterior to which is another single tooth. These are all anterior to the cervical fissure, on the posterior margin of which two teeth stand close together, while scarcely half way between these and the posterior margin are two others placed side by side, and two others wider apart stand upon a protuberance on the ridge of the posterior margin. The line of demarcation that separates the branchial chamber from the internal viscera is clearly defined, and armed with a tolerably strong tooth near the posterior extremity, and indications of others exist along the line.

The pleon gradually narrows towards the posterior extremity of the animal, and is armed in the median line of the five anterior somites with a series of strong anteriorly-directed teeth which gradually increase in size posteriorly, so that the fifth is the largest. On the sixth somite there is no tooth, but there is a double ridge that unites in front of the posterior margin.

The telson is long, narrow, and pointed.

The ophthalmopoda (Pl. XIV. fig. 2c, *a*) are rather broad and distinct on the dorsal surface, the anterior margin of which is armed with a small outwardly-directed tooth. Judging by the translucent appearance of the external tissue, one lens appears to be situated at the posterior dorsal extremity of the orbit, and another on the anterior point of the ophthalmopod, which is depressed and covered by the anterior angle of the carapace, and projects outwards between it and the second or outer pair of antennæ.

The first pair of antennæ (fig. 2c, *b*) has the first joint produced internally and anteriorly to a point that reaches as far as, or beyond, the extremity of the third joint of the peduncle, and thins out to a ridge that is directed obliquely upwards, and is not armed with teeth but fringed with hairs only. A large round lobe, containing the auditory apparatus, exists within the outer margin, the opening to which consists of a narrow transverse slit armed at the outer margin with two sharp, strong teeth, one anterior and the other posterior to the opening. The second and third joints are cylindrical and successively smaller, and support two flagella of which the inner is as long as the carapace, the other is slender and short, being but little longer than the peduncle of the antenna.

The second pair of antennæ (fig. 2c, *c*) articulates with the metope entirely; the coxa being free carries a long and prominent phymacerite, the extremity of which is compressed against the surface in a depression on the under side of the first pair of antennæ. The second joint carries on the outer anterior extremity a long narrow ovate centrally-pointed scaphocerite; the third and fourth joints are cylindrical and equal in length, and the terminal flagellum is as long as and resembles that of the internal of the first pair.

I have examined the oral appendages on the left side and find that the variation from those of the preceding species is but small; the mandibles are of the same form, with the same kind of synaphipod, while the anterior lip or cheiloglossa fills up the concave hollow within their blades.

The first pair of siagnopoda differs in having the inner branch a little more slender than the outer.

The second pair has the margin of the mastigobranchia more densely fringed with hair.

The third pair is less constricted towards the apex, and the chamber or pocket is less defined, the movable valve is ovate, and the hairs on the inner margin are more numerous.

The gnathopoda are alike, except that in the second pair the dactylos terminates in a sharper extremity.

The first pair of pereiopoda is long, narrow, and not unlike that of the preceding species, excepting some small points of armature. There are two small but conspicuous teeth on the outer margin of the meros, and one on the external distal angle; the carpos is unarmed excepting a small tooth on the outer distal angle, and the propodos is smooth and free from armature.

The second, third, and following pairs of pereiopoda do not differ in any marked feature from those of the preceding species, excepting that the dactylos of the last pair is shorter and fringed with hairs. There is no striking difference in the appendages of the pleon from those of *Polycheles baccata*.

Observations.—The specimen from which this description was taken was the only one found at Station 218. The only other Crustacean of this group associated with it was one that I have named *Pentacheles obscura*, from the uncertainty I feel as to its true character; it may be a degraded representative of the female of the above. But at Station 170, near the Island of Kermadec, there was taken an imperfect specimen of what I consider may be the female of *Polycheles helleri*, and the cephalon of which is figured in Pl. XV. fig. 1. It corresponds in general character with the male, the ornamentation being slightly different and more distinct. The dorsal surface of the carapace is covered with more defined granular points, from each of which a minute hair springs. The arrangement of small teeth on the median dorsal line is similar in both. There are two small teeth just within the anterior margin at the interior angle of the orbit. The serratures on the lateral margins correspond, but are more pronounced, and are seven in the anterior region, four in the median, and fourteen in the posterior, which gradually lessen in degree and disappear at the posterior margin. The denticulation on the dorsal median ridge of the pleon corresponds with the male specimen, but the increase in size posteriorly is not so conspicuous, and the sixth somite is smooth.

The tooth on the ophthalmopod is small and there are two teeth (although I have only figured one) near the auditory fissure of the first pair of antennæ.

The flagella of the antennæ as well as the structure of the peduncles correspond in the two specimens, and there is no important variation in the structure of the appendages of the mouth.

The first pair of pereiopoda is imperfect, but the meros is armed with two small teeth on the outer and two on the inner margins, which last differ from those in the male specimen.

The other pairs correspond, but the posterior pair has the last joint broken off.

The specimen, as I before said, is imperfect. Besides the fingers of the large pair of claws the posterior pair of pereiopoda is only perfect as far as the propodos, and there is no evidence to determine the character of the appendages in this specimen, which is undoubtedly a female, the vulva being visible on the third pair of pereiopoda.

The first pair of pleopoda is small, slender, and feeble; the second pair carries but a single stylamblys. This specimen was taken at half the depth of the preceding, at a temperature of 43°, on a bottom of volcanic mud.

The branchial arrangement corresponds with that of *Pentacheles* in the delicate character of the mastigobranchia, which is of great tenuity and shorter than the plume with which it is associated.

It will be interesting to compare with this species that which is described by Smith as *Polycheles sculptus*,[1] and with *Pentacheles sculptus*,[2] and *Pentacheles spinosa*[3] of A. Milne-Edwards.

Professor A. Milne-Edwards' description is short and agrees with *Polycheles helleri* in every point mentioned. But Mr. Sidney Smith's description is more complete and is fully illustrated by good figures of the entire animal in both dorsal and ventral aspects, as also of most parts in detail. After studying the paper and figures carefully I can detect no distinction of sufficient importance to separate *Pentacheles sculptus* from *Polycheles helleri*, nor would it have taken much consideration to decide their identity had it not been for the generic character of the fifth pair of pereiopoda, and that the specimens were procured from localities so widely apart. *Polycheles helleri* lives in the Eastern Pacific at depths of from 500 to 1000 fathoms, and *Pentacheles sculptus* in the Western Atlantic, at about 600 fathoms.

It is highly probable that many of the animals that we determine as specifically distinct, because they are found in widely separated localities, and exhibit some greater or less deviation from each other, would cease to be considered such if they lived side by side, and there can, I think, be little doubt that many of our museum specimens are not really species.

A comparative examination of the Atlantic *Pentacheles sculptus* with that of the Pacific *Polycheles helleri*, will elucidate clearly the point in question.

[1] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. v. p. 269, 1880.
[2] *Bull. Mus. Comp. Zool.*, vol. x. p. 23, pls. iii., iv., 1882.
[3] *Bull. Mus. Comp. Zool.*, vol. viii. p. 66, 1880.

The armature of the two species may be best appreciated side by side, and formulated as below.

The marginal fringe of the carapace is

Male, *Polycheles helleri*, ...	7–4–5, gradually decreasing.
Female, *Polycheles helleri*, ...	7–4–14, gradually decreasing.
Female, *Pentacheles sculptus*, ...	6–3–6, gradually decreasing.

Median dorsal ridge

Male, *Polycheles helleri* (counting the rostral teeth), . . .	2·1·1·2·1 = 2·2·2.
Female, *Polycheles helleri* (counting the rostral teeth), . .	2·1·1·2·1 = 2·2·2.
Female, *Pentacheles sculptus* (counting the rostral teeth), . .	2·1· ·2·1 = 2·2·2.

On the inner side of the orbital notch the frontal margin is armed with a small tooth in *Pentacheles sculptus*, and so in the female of *Polycheles helleri*.

"In front of the cervical suture there is an irregular longitudinal dorso-lateral line of five minute spines; on each side of and behind these, a single spine on each side on the posterior edge of the cervical suture." The last of these alone is present in the male of *Polycheles helleri*, in the female there is, besides, a small tooth on the inner side of the orbital notch, and one or two nearer the median line, but not in a line corresponding with those given in Sidney Smith's plate.

"Extending from the posterior margin nearly to the cervical suture, there is a sharp sublateral carina parallel to the lateral margin, about a third of the way from it to the median carina and armed with five or six small spines."

These also exist in *Polycheles helleri*, and traverse the line corresponding with the upper edge of the inner wall of the branchial chamber.

The character of the ophthalmopoda is similar, and the passage in this description (page 137) relating to the translucent appearance of the external tissue of the eye was in type before Smith's remarks on the same were published. I do not mention this to plead for priority of observation, but to demonstrate, from independent sources, how close the relationship between the two animals from antipodal regions really is, and that Mr. Smith's observation supports this opinion.

Excepting the termination of the fifth pair of pereiopoda in the males there is no structural distinction between the two forms, so far as I can determine, but that of a tooth or two on the outer surface of the carapace, and I think there are few naturalists but must feel that the two specimens, except for the generic feature, might have been classified as belonging to one and the same species, so closely does *Polycheles helleri* resemble *Pentacheles sculptus*.

Pentacheles, Spence Bate.

Pentacheles, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. ii. p. 276, 1878.

All the pereiopoda are more or less perfectly chelate in both sexes, the ophthalmopoda are immovably lodged in a notch in the anterior dorsal surface of the carapace, and the anterior portion projects beneath the antero-lateral angle of the carapace, which is produced anteriorly to a level with the central rostral tooth.

Geographical Distribution.—The range of this genus comprises probably the whole Pacific and Atlantic Oceans, as species have been taken in the sea around the Philippine Islands as well as on the western coast of South America and at the intermediate stations of the Fiji and Kermadec Islands. A. Milne-Edwards describes two, *Pentacheles validus* and *Pentacheles agassizii*, from the West Indian region of the Atlantic, and Sidney Smith has taken *Pentacheles sculptus* in Mid Atlantic.

Pentacheles obscura, Spence Bate (Pl. XV. fig. 2).

Pentacheles obscura, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. ii. p. 279, 1878.

Carapace furry on the dorsal surface. Lateral margins furnished with few teeth, not conspicuous from being intermingled with hairs. Regions not well defined marginally. Anterior division furnished with three or four small teeth separated from each other, median with three, posterior division with five or six. Anterior median armed with two rostral teeth; half way to the cervical suture are two more, posterior to which is one small one, and the rest of the median ridge is either smooth or crested with small granulations. Pleon carinate; central ridge tuberculate rather than denticulate.

Length, 25 mm. (1 in.).

Habitat.—Station 218, March 1, 1875; lat. 2° 33′ S., long. 144° 4′ E., north of New Guinea; depth, 1070 fathoms; bottom, blue mud; bottom temperature, 36°·4.

This specimen is in a very poor condition, and has much the appearance of one that had recently cast its skin. The dorsal surface of the carapace is of a rougher character than usual, the small granulations that carry the short curved hairs being rather prominent. The median ridge is furnished with a double row of granulations, except at the anterior extremity where there are two small teeth side by side, and there are two others similarly placed on the gastric region. The denticulation of the lateral margin is not clearly determinable in consequence of its hirsute character.

The ophthalmopoda support a strong tooth, rather longer than usual, and are implanted in a wide-mouthed but not deep notch.

The first pair of antennæ has the inner margin of the first joint of the peduncle

very thin, smooth, turned upwards, and the anterior angle rounded, and fringed with hairs; the outer anterior angle is armed with a small tooth anterior to the auditory fissure.

The second pair of antennæ has the peduncle quite as long as that of the first, and the scaphocerite is narrow, lanceolate, scarcely reaching to the extremity of the peduncle.

The several organs of the mouth, so far as they could be observed, appear to have a close resemblance to those of *Polycheles helleri;* so also has the gnathopoda.

The first pair of pereiopoda has the meros smooth to ordinary vision, but a low magnifying power shows several minute points on both the inner and the outer sides.

The fifth pair of pereiopoda (fig. 2 *o*, ♀) is imperfectly chelate, induced by a short pollex; the posterior and distal angles of the propodos are produced to half the length of the dactylos; the dactylos is long, and curved in the same direction as the pollex, its convex or proximal side is smooth, the concave or outer side being hirsute, both forming an imperfect grasping claw. Somewhat similar is the condition of the three posterior pairs; that is, the dactylos and pollex curve in a direction parallel with each other, and impinge together so that they lie in the same direction instead of opposing each other as finger and thumb.

The first pair of pleopoda is that of a female, as this specimen undoubtedly is; and I was much inclined to believe it to be that of *Polycheles helleri*, but the finding of a specimen, which is evidently the female of *Polycheles helleri*, off Kermadec Island, has compelled me to hesitate as to the relationship of this specimen. I have, consequently, associated it with those species in which the form of the fifth pair of pereiopoda more nearly resembles this.

The mastigobranchia attached to the coxa of the second pair of gnathopoda, and the well-developed character of those attached to the pereiopoda, are similar to the same in *Pentacheles lævis.*

Pentacheles lævis, Spence Bate (Pl. XV. fig. 5).

Pentacheles lævis, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. ii. p. 278, 1878.

Dorsal surface of the carapace long-ovate, free from any armature on the surface except two small teeth equidistant and longitudinally placed on the median line anterior to the cervical fossa. Rostral margin bi-dentate; inner frontal angle of the orbital notch produced to a strong tooth, serrate on the outer margin. The lateral marginal denticulation is bold anteriorly, gradually decreasing posteriorly. The anterior division is but imperfectly defined from the median, and together they are armed with nine teeth, and the branchial or posterior with fifteen or sixteen. Dorsal median line of the pleon but slightly elevated and imperfectly dentate. The posterior pair of

pereiopoda is imperfectly chelate in the female, the pollex being shorter than the dactylos.

Habitat.—Station 214, February 10, 1875; lat. 4° 33′ N., long. 127° 6′ E.; between Samboangan and New Guinea; depth, 500 fathoms; bottom, blue mud; bottom temperature, 41°·8. Length, 38 mm. (1·5 in.), female.

Station 300, December 17, 1875; lat. 33° 42′ S., long. 78° 18′ W.; west of Valparaiso; depth, 1375 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·5. Length, 47 mm. (1·75 in.), female.

Although the animal is named *lævis*, there is a short, sparsely-scattered fur on the surface of the carapace; but, with the exception of two small teeth on the median line anterior to the cervical fissure, the dorsal surface of the carapace is free from armature. The teeth on the lateral margins are very even and regular, and gradually increase in importance from the posterior margin of the carapace to the anterior angle, where they become tolerably large and decided. In the median line of the frontal margin are two divergent upwardly-pointed rostral teeth. Outside these, on the inner angle of the orbital notch, is a strong tooth pointing forwards and slightly upwards; it is serrate on the outer side. The orbital notch is narrow. The somites of the pleon are dorsally smooth, and are slightly elevated into a median carina, the four anterior somites of which only possess dentations (fig. 5P).

The ophthalmopod is armed on the anterior surface with a sharp tooth.

The first pair of antennæ has the inner margin of the projecting scale of the first joint of the peduncle serrate, with its anterior point reaching as far as the distal extremity of the third joint of the peduncle.

The second pair has the flagellum broken short, and has a small scaphocerite that does not reach beyond the ultimate joint of the peduncle.

The mandible and oral appendages correspond closely with those of other species.

The first pair of gnathopoda much resembles that of *Stereomastis suhmi*.

The second pair is damaged in this specimen, the joints beyond the ischium being wanting; the coxa is broad and hairy, and carries a tolerably long mastigobranchia, but no branchial plume.

The first pair of pereiopoda is broken off at the coxa, to which is attached a podobranchia and a mastigobranchia, the latter being as long as the plume; to the articulation are joined two arthrobranchiæ, but I could not detect a pleurobranchial plume.

The second pair of pereiopoda likewise carries a long podobranchial plume and an equally important mastigobranchial plate, two arthrobranchiæ, and a pleurobranchia.

The third and fourth pairs carry similar branchial plumes to the second; but the fifth pair is shorter than any of the preceding pereiopoda, and has no branchia attached except a small pleurobranchial plume. The whole may be tabulated as follows :—

Pleurobranchiæ,	...	...	...	1	1	1	1		
Arthrobranchiæ,	...	...	2	2	2	2	...		
Podobranchiæ,	...	...	1	1	1	1	...		
Mastigobranchiæ,	...	1	1	1	1	1	...		
	h	i	k	l	m	n	o		

The first pair of pleopoda in this specimen, which is a female, is small and feeble. The second is biramose, and the inner branch carries a single stylamblys fringed with ciliated hairs, as do all the other pairs of pleopoda until the sixth, which forms part of the rhipidura.

Observations.—The first specimen of this species, which was not a very perfect one, was taken south-east of the Philippine Islands, at about seventeen degrees west and seven degrees north of where *Pentacheles obscura* was taken.

The second specimen was taken near Juan Fernandez, at three times the depth, on a similar bottom but at a temperature six degrees lower.

The two localities of this species, being more than ten thousand miles apart, induced me to compare the specimens with great care.

Pentacheles gracilis, n. sp. (Pl. XVI. figs. 1, 2).

Carapace long-ovate; anterior margin furnished with two sharp rostral teeth directed obliquely upwards; a similar strong, sharp tooth is directed forwards at the inner angle of the orbit. Outside the orbital notch is a similar tooth directed obliquely inwards, beyond which the lateral angle of the carapace projects anteriorly in the form of a strong, sharp tooth, passing obliquely upwards, outwards, and anteriorly beyond the extremity of the median or rostral teeth. The lateral margins of the carapace are evenly denticulate, and divided at the cervical and hepatic fissures. There are ten teeth on the anterior, three on the median or hepatic, and fourteen on the posterior or branchial margins. These last lessen in size as they proceed posteriorly. Between the several teeth are a few hairs. The median dorsal ridge is armed with a row of single teeth, gradually decreasing in size as they proceed posteriorly. The general surface is polished and sparsely covered by small granular points, from which spring short, curved hairs; the branchial region is clearly defined by a baccate or minutely denticulate line.

The dental armature of the carapace may for convenience be formulated as—

Marginal, ...	10—3—14
Dorsal ridge, ...	2·1·1·1·1·1·1·1·1·1—1·1·1·1·1·1·1·1·1

The pleon is smooth and carinated in the median line; the carina in the three anterior somites culminates into anteriorly-directed teeth.

The first pair of pereiopoda has the meros smooth on the outer margin, with a strong tooth at the external carpal angle, and armed on the inner margin with several small teeth, of which in our specimen four are well defined.

Length (female), 60 mm. (2·25 in.).

Habitat.—Station 174c, August 3, 1874; lat. 19° 7′ 50″ S., long. 178° 19′ 35″ E.; off Kandavu Island; depth, 610 fathoms; bottom, coral mud; bottom temperature, 39°. One specimen.

This species is of a very beautiful and graceful form. The lateral margins are slightly curved outwards, and the carapace possesses a somewhat ovate shape. The teeth on the lateral margins of the carapace are very even and regular, with a tendency to diminish gradually in size as they approach the posterior margin. The tooth at the anterior angle of the carapace is very strong and prominent, and projects beyond the line of the median or rostral teeth. There is a sharp and prominent tooth on the inner and outer angles of the orbital notch. There is a single row of many teeth in the median line. Several of the anterior are well defined, but posteriorly they diminish, and become mere protuberances.

The internal margin of the branchial region is defined by a wavy, baccated line, separating the branchial from the cardiac region.

The posterior margin of the carapace is smooth and free from armature, and is overlapped by the lateral extremity of the first somite of the pleon.

The first somite of the pleon is very short and narrower than the carapace. The anterior half is depressed, and slides under the carapace when the animal is extended. The posterior half is elevated, armed in the median line with a strong, sharp, anteriorly-directed tooth, and fringed along the posterior margin with a row of fine cilia. The lateral extremity consists of the coxal plate reduced to a strong calcified mass that is curved forwards, and, as a pleocleis, overlaps and holds down the posterior margin of the carapace.

The second somite is longer and slightly narrower than the first, articulating with it at each lateral extremity by a small ball-and-socket joint, beyond which the coxal plates are large, and project downwards and extend forwards to the margin of the carapace, and posteriorly overlap the anterior half of the coxal plate of the third somite; a well-defined fossa passes obliquely from the postero-lateral angle of the somite to the central line of the posterior or elevated portion, where it is armed with a strong, sharp and

anteriorly-directed tooth: the third, fourth, and fifth somites are similar, except that posteriorly they become narrower, carry a smaller coxal plate, and have the dorsal median tooth diminishing gradually to a cusp: the telson is long and tapering, armed on the median line near the base with a small posteriorly-directed cusp.

The ophthalmopod is situated in a wedge-shaped cleft, which is narrower at the base than at the anterior margin, where it is armed with a sharp and rigid tooth, and projects downwards and outwards, being compressed between the upper surface of the second pair of antennæ and the extension of the latero-anterior angle of the carapace.

The first pair of antennæ has the anterior extremity of the inner squamiform process produced to a sharp tooth, and armed along the inner margin, which is curved upwards, with two or three small teeth and a few hairs, and carries one sharp tooth on the outer anterior angle above the auditory slit; the two succeeding joints of the peduncle are short, not reaching so far as the apex of the inner tooth of the first joint; the outer flagellum is about one-fourth the length of the inner, and more slender.

The second pair of antennæ has the phymacerite long, and compressed closely against the inferior surface of the first joint of the first pair of antennæ; the extremity of the peduncle reaches beyond that of the first pair; the flagellum is as long as the inner branch of the first pair; and the scaphocerite, which is long, narrow, and pointed, does not extend beyond the extremity of the last joint of the peduncle, although so figured in the plate (fig. 1c. *c*). The surface of the peduncle is covered with hairs, and so is the margin of the scaphocerite.

I have not disturbed the oral appendages, as the specimen is unique, and the general similarity of the external parts is suggestive of no great variation in hidden structure.

The second pair of gnathopoda carries a small and slender mastigobranchia, but has no podobranchial plume attached. It corresponds closely with the same organ in *Pentacheles lævis.*

The first pair of pereiopoda is long and slender. The meros is smooth upon the outer margin, except that it is armed with a single tooth on the distal or carpal extremity; the inner margin is furnished with a row of small teeth, the three or four nearer the ischium being sharp and well defined; the carpos is long, slender, and smooth, except for one small tooth at the external distal angle; the propodos is fringed with fine teeth on the external margin and a few rudimentary ones on the inner; the dactylos is parallel with the pollex, excepting that both are curved laterally inwards and overlap each other when closed. The coxa carries a long and broad mastigobranchia, with a podobranchial plume attached to it. At the articulation are two arthrobranchiæ, a large posterior and a small anterior, but no pleurobranchia.

The second pair of pereiopoda is tolerably robust. It is short and carries two arthrobranchiæ, a podobranchia, and a mastigobranchia.

The two following pairs are more slender, and possess a similar branchial arrangement.

The posterior pair of pereiopoda is smaller than either of the preceding, and terminates in an unequal and imperfect chela, the pollex being shorter than the dactylos, and curved in the same direction, so that the pollex seems to impinge posteriorly against the dactylos. This pair supports no podobranchia or arthrobranchia; but a pleurobranchial plume is attached to the inner wall of the chamber, and the whole may be tabulated as follows :—

Pleurobranchiæ,	...	...	...	1	1	1	1		
Arthrobranchiæ,	...	...	2	2	2	2	...		
Podobranchiæ,	...	...	1	1	1	1	...		
Mastigobranchiæ,	...	1	1	1	1	1	...		
	h	i	k	l	m	n	o		

The first pair of pleopoda in the female is small, slender, and uni-branched, while the four succeeding pairs are large and biramose, carrying on the inner side of the inner branch a single stylamblys, fringed with a few plumose hairs on the approximate side, and tipped with a bunch of cincinnuli.

The rhipidura offers no distinctive variation from the same in allied genera.

Observations.—This species was taken about one degree south-west of the Fiji Islands, associated with *Pentacheles euthrix* and *Stereomastis auriculata.*

Pentacheles euthrix, (Willemoes-Suhm, MS.) (Pl. XVII.).

Willemœsia euthrix, Willemoes-Suhm, MS.
Pentacheles enthrix, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. ii. p. 280, 1878.

Margins of the carapace slightly convex; antero-lateral angles slightly approximating, and somewhat abruptly turned upwards; anterior division armed with eight teeth, and defined from the central, which has four, and the posterior, which has twelve or thirteen. The anterior margin has two rostral teeth, two small ones above the first pair of antennæ and one within the margin of the internal angle of the orbit. The median longitudinal ridge is armed posterior to the two rostral teeth by two single and one double and another single one before the cervical ridge, and behind it a double and after a space another double, and on the anterior edge of the posterior margin three stout teeth or cusps on each side. All of which may be formulated as—

Marginal,	8—4—13
Dorsal crest,	2·1·1·2·1—2·2·2

On the pleon the carina is produced to a sharp tooth on all the somites anterior to the fifth, where it is reduced to a strong cusp, and is almost lost on the sixth somite.

The first pair of pereiopoda has the meros armed with two small teeth on the outer margin near the base, and a small one near the distal external angle; and in some

specimens there are several small teeth on the inner margin; the propodos is also fringed on both margins with several minute denticles, and the external or dactyloid angle is armed with a strong cusp or tooth. The posterior pair of pereiopoda is chelate, the dactylos and pollex being subequal in both sexes.

Length (male and female), 57 mm. (2·25 in.).

Habitat.—Station 170, July 14, 1874; lat. 29° 55′ S., long. 178° 14′ W.; off the Kermadec Islands; depth, 520 fathoms; bottom, volcanic mud; bottom temperature, 43°.

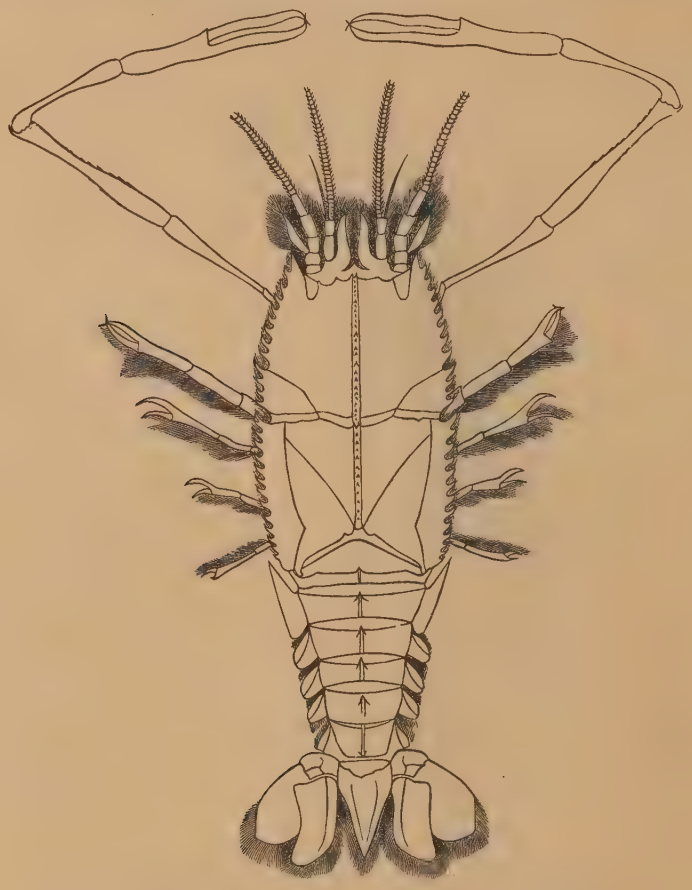

Fig. 33.—*Pentacheles euthrix.* From a drawing by Dr. v. Willemoes-Suhm.

Station 170A, July 14, 1874; lat. 29° 45′ S., long. 178° 11′ W.; near the Kermadec Islands; depth, 630 fathoms; bottom, volcanic mud; bottom temperature, 39°·5. Two female specimens.

Station 173, July 24, 1874; lat. 19° 9′ 35″ S., long. 179° 41′ 50″ E.; off Matuku; depth, 315 fathoms; bottom, coral mud. Male.

The surface of the carapace is granulated; out of each granulation springs a small

curved hair. The lateral margins of the carapace are very nearly parallel; anteriorly they converge slightly towards each other, and the anterior angle is produced slightly in advance of the anterior margin. The lateral margins are furnished with well-defined teeth throughout their entire length, the several divisions being well marked; the anterior, which is turned somewhat abruptly upwards, has eight teeth including the anterior angle; the second or central division has four or five. There were four on each side in one specimen, and four on one side and five on the other in another, so that there is a tendency to variation. The posterior has thirteen teeth. The anterior or frontal margin between the orbits is convex, and armed with two rostral teeth, one on each side of the median ridge; four or five small denticles arm the frontal margin between the rostral teeth, and two larger ones behind and above the first pair of antennæ, outside which are two other small denticles, then a tolerably large one is situated within the margin at the inner angle of the orbital notch, the outer margin of which as far as the extremity of the latero-anterior angle of the carapace being smooth. Thelongitudinal median ridge is furnished with a double row of small bead-like granulations, and also, at some distance behind the rostral teeth, with a single tooth, a little behind it with another, then two side by side, then a single one anterior to the cervical fossa, behind which the double baccated row still continues to the posterior margin, and is armed close behind the cervical fossa with two teeth side by side, and at about one-third of the length of the ridge with two more similarly arranged in the female, but without any in the male. On the anterior edge of a ridge along the posterior margin of the carapace, on each side of the median line, is one sharp, strong, obliquely and anteriorly directed tooth; at a little distance is a second, and then a third, but the two latter are smaller and less important. The first somite of the pleon has a small, central, anteriorly-directed tooth, and on the anterior margin, just within the peltecleis, is another small and slender tooth; outside the peltecleis the marginal extremity of the somite terminates in a rounded protuberance fringed with cilia, that overlaps the postero-lateral angle of the carapace. The second somite of the pleon is armed in the centre with a tooth a little larger than that of the preceding; the rest of the somite is smooth and polished, as is also the coxal plate at the sides. The two succeeding somites resemble the second, nor are any of the central teeth more important; that on the fifth is less so, and is little more than a cusp, while on the sixth somite the slightest indication of a carina only exists at the posterior margin, and on the telson there is a small bead-like cusp near the anterior margin.

The ophthalmopod is lodged in a notch in the carapace that is much broader at the anterior margin, and narrows posteriorly; it carries a small, pointed cusp on the anterior surface, and passes outwards beneath the projecting angle of the carapace, and terminates in two small nodules, one on the outer, the other on the lower side.

The first pair of antennæ (C, *b*) has the squamose process of the first joint produced

to a strong, sharp tooth, directed upwards obliquely and anteriorly, extending beyond the extremity of the third joint of the peduncle, having the margin serrate with several small teeth, mingled with long hairs; the fissure leading to the auditory chamber is armed on the outer extremity of the posterior margin with one strong, sharp tooth; the second and third joints of the peduncle are cylindrical, and the third is shorter than the second; the terminal flagella are unequal, the outer being much more slender than, and about one-fourth the length of the inner.

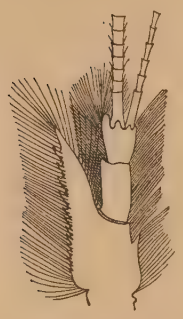

FIG. 34.—Inner antenna of right side, seen from above. From a drawing by v. Willemoes Suhm.

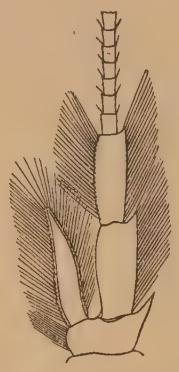

FIG. 35.—Outer antenna of right side, with scale, seen from below. From a drawing by v. Willemoes-Suhm.

The second pair of antennæ (*c*) is implanted just outside the first, and the coxa carries a large curved phymacerite (*o.p.*) the extremity of which is rather smaller in diameter than the rest of the shaft, and is bent up against and lodged in a depression on the outer and under surface of the first joint of the first pair of antennæ; the second and third joints are closely impacted into one, so that it is difficult to determine which is the second and which the third; the inner anterior angle is armed with a strong sharp tooth, and the outer supports a long and pointed scaphocerite fringed with hairs; on the under surface, behind the scaphocerite, is a large fasciculus of soft hairs; the last two joints of the peduncle are subcylindrical, and each produced to a strong, pointed cusp or tooth at the outer distal angle, the most distant of which reaches beyond the extremity of the scaphocerite; the flagellum is of about the same length and size as the inner branch of the first pair.

The mandibles and other oral appendages offer nothing to distinguish them from those of the other species.

The first pair of gnathopoda supports a small rigid process fringed with hairs, attached to the outer distal angle of the coxa, the rudiment apparently of a mastigobranchial appendage; the basis is armed on the inner surface with a row of strong cusps or blunt teeth; the ischium is short; the meros long and ovate; the carpos is cylindrical, slightly curved, broader at the distal extremity than at its meral; the propodos is short, cylindrical, smaller in diameter than the carpos, and armed with a few spine-like hairs; the dactylos is slender, sharp, and styliform. The entire appendage is fringed with long and strong hairs on the inner and distal surfaces, and with short, fur-like hair on the outer.

The second pair of gnathopoda carries a rudimentary membranous mastigobranchial appendage attached to the outer extremity of the coxa: the basis is short, the ischium long; the meros half the length of the ischium; the carpos shorter than the meros; the propodos

subequal to the carpos, but not so great in diameter; the dactylos sharp, long and styliform.

The first pair of pereiopoda exhibits, upon close inspection, the presence of small points or cusps on the inner and outer margins of the propodos, carpos, and meros, in some specimens more abundant than in others, but there are two that, although they vary in proportion, are tolerably constant in position on the outer surface of the meros. There is also one at the outer distal angle of the meros that appears to be constant; those on the inner and outer distal angles of the carpos are not so constant, more especially that on the outer. There is a strong tooth also at the outer or dactyloid angle of the propodos. It carries a small podobranchial plume attached to a long stalk, that supports a small and delicate mastigobranchial appendage, behind which are two small arthrobranchial plumes.

The second, third, and fourth pairs of pereiopoda offer no appreciable distinction from those in other forms of this group. The gills that each support are the podobranchiæ, a small and delicate mastigobranchial lash, two arthrobranchiæ, and a pleurobranchial plume. These increase in proportion as they proceed posteriorly, and those of the fourth pair are large and well developed, but all the mastigobranchiæ are of extreme tenuity, except at the stalk, which is flat and more rigid.

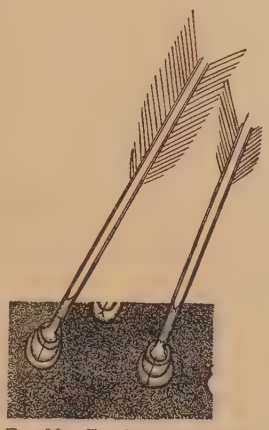

Fig. 36.—Two hairs on a section of chitin, showing their structure. From a drawing by v. Willemoes-Suhm.

The fifth pair of pereiopoda is shorter than the others, and terminates in a subequally fringed chela, of which the pollex is rather shorter than the dactylos, and is concave or spoon-shaped. Above this pair, attached to the pleuron on a prominent protuberance, is a pleurobranchial appendage that is not equal in proportion to the podobranchia of the preceding pair.

The branchiæ may be tabulated as follows:—

Pleurobranchiæ,	. . .	...	...	...	1	1	1	1	
Arthrobranchiæ,	. . .	...	...	2	2	2	2	...	
Podobranchiæ,	. . .	...	...	1	1	1	1	...	
Mastigobranchiæ,	. . .	...	...	1	1	1	1	...	
		h	i	k	l	m	n	o	

The first pair of pleopoda is of the form common to the male and female. The others are biramose.

Observations.—Dr. v. Willemoes-Suhm, in his notes on this species, says, "July 14, 1874. ♀. Two specimens were taken off Kermadec Island in 500 fathoms; one, the smaller, being 35 mm. in length, and the other 47 mm. The carapace was 22 mm. long and 19 mm. wide. The length of the large chela was 65 mm. but does not equal that of *Willemœsia leptodactyla*, and is distinguished from it:—

"*Firstly*, by the absence of a tooth on the chela.

"*Secondly*, by the pointed tooth-like formation of the first joint of the inner antennæ.

"*Thirdly*, by the concavity where we might expect the eye. The spot is covered only by a thin chitinous skin, and not by the granular mass on the carapace.

"*Fourthly*, by the various divisions on the carapace.

"*Fifthly*, by the pointed tooth on each side of the first somite of the pleon; and

"*Finally*, by several details."

This species has a close general resemblance to *Polycheles baccata*, and had I not been able to determine both sexes of this latter species, I should have considered myself justified in believing them to be the two sexual forms of the same species. Our specimens were taken north of the Kermadec Islands, and one about 100 miles south-east of the Fiji group.

Stereomastis,[1] n. gen.

This genus differs in nothing externally from *Pentacheles*, but is established to receive those species in which the mastigobranchial lash does not exist.

Difference of internal structure as a specific character is of more value than any external distinction, which, though more convenient for classification, is of little importance if it does not represent structural variation.

Stereomastis suhmi, Spence Bate (Pl. XV. figs. 3, 4).

Pentacheles suhmi, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. ii. p. 278, 1878.
„ „ on Pl. XV. figs. 3, 4.

Carapace with lateral margins subparallel; anterior division armed with five strong teeth, median with two, and the posterior with eight or nine teeth equally strong, continuing to the posterior margin. Frontal margin with a sharp tooth at the inner angle of the orbit, and two central rostral teeth; posterior to which on the central dorsal ridge are two teeth, one behind the other; then at an equal distance two side by side, and a similar pair behind them, and then one single tooth anterior to the cervical fossa, on the posterior margin of which is a prominent pair, behind which, near together, are two single teeth, and then after a considerable space on the posterior ridge of the carapace is another strong pair, more widely separated from each other.

The armature of the carapace may be expressed as—

Marginal teeth, ...	5—2—8
Dorsal ridge, ...	2·1·1·2·2·1—2·1·1· ·2

[1] The name is derived from στερεω, to be deprived of, and μάστιξ, a lash (Ionic, μάστις).

On the pleon the dorsal median teeth are very prominent, and continue to the telson; they are all anteriorly directed, and exhibit a tendency, which increases posteriorly, to carry a second small tooth, which on the sixth somite breaks into a serrate arrangement, and this is repeated on the telson, though to a less extent.

The first pair of pereiopoda is long and slender, and has the meros armed with one, two, or three sharp teeth on the outer margin, and one at its outer distal angle, and the carpos armed with a sharp tooth on the outer margin, a little behind the propodal joint.

The posterior pair of pereiopoda has the pollex in both sexes shorter than the dactylos.

Length—male, 46 mm. (1·8 in.); female, 50 mm. (2 in.).

Habitat.—Station 305B, January 1, 1876; lat. 47° 48′ S., long. 74° 46′ W.; south-western coast of South America; depth, 160 fathoms; bottom, blue mud.

Station 311, January 11, 1876; lat. 52° 45′ 30″ S., long. 73° 46′ W.; near Magellan Strait; depth, 245 fathoms; bottom, blue mud; bottom temperature, 46°. Nine specimens.

There was only a single specimen of this species, and that a male, taken at Station 305B, in the channel between the coast and the islands that lie upon the Pacific side of Patagonia. But at Station 311, where the situation was very similar, though nearer the Strait of Magellan by some three hundred miles, on a similar sea-bottom, and within the same chain of littoral islands, there was a larger number taken, a circumstance that has allowed me to examine in detail the structure of this species more minutely than in most of the other forms, of which the specimens were fewer.

The lateral margins are nearly parallel to each other, the denticulation is bolder than usual and slightly curved upwards and forwards, and the anterior angles approaching a little towards each other; the surface is sprinkled with small denticles, and a row of more important ones runs from the post-orbital angle posteriorly and inwardly. In some specimens the anterior tooth is larger than either of the others, and at the opposite extremity they are connected on the outer side with a group of others; on the ridge of the cervical suture, half way between the median line and the lateral margin, is another group of three or four small sharp teeth. Corresponding with the line of separation between the branchial region and that of the internal viscera, is a curved row of small teeth, commencing just behind the cervical fossa and running nearly parallel with the lateral margin to the posterior extremity of the carapace. On the inner side, between this row of denticles and the median ridge of the carapace, is a group of several other teeth sparsely scattered about, and the entire surface is sprinkled with short hairs, the longest of which are on the branchial region. Besides the rostral teeth there is one situated on the anterior margin at the internal angle of the orbital notch.

The somites of the pleon are all dorsally armed with strong anteriorly-directed teeth, each carrying a more or less conspicuous denticle behind it, of which that on the third

somite is the most prominent, while on the sixth somite the larger tooth is represented by a number of small denticles, a condition that is repeated to a less extent on the anterior surface of the telson. At the lateral margins of the several somites, and fused with them, is a large flat coxal plate, of which that of the second is the largest, and the proportions gradually diminish to the sixth, while that of the first somite is either absent or reduced to a minimum.

The first somite of the pleon is not so wide as to reach to the lateral margins of the carapace, but the extremities are directed forwards and overlap the posterior margin, from which a strong cusp is posteriorly produced and rests upon the upper surface of the posterior division of this somite, on the inner side of which is a second cusp or tooth. Thus we find that the lateral extremity of the somite keeps down the margin of the carapace, whereas a cusp of the latter presses down the surface of the somite, each retaining the other in its place by a specially-formed cusp or bolt (the peltecleis). A corresponding cusp exists on the posterior margin of the somite articulating with a smaller one on the anterior margin of the second somite, in a limited ball and socket articulation, and this is repeated on each somite successively.

The ophthalmopod is fixed in a long and narrow orbit in the frontal margin of the carapace, and carries a tooth on the anterior surface, from which it suddenly narrows laterally, becoming depressed so as to pass beneath the latero-anterior angle of the carapace, which is produced anteriorly, and elevated to the plane of the dorsal surface of the carapace, and so passes over the eye and protects it. The ophthalmopod appears to be firmly united to the carapace at the inner margin of the orbit, but not on the outer, against which it is closely compressed, passing through a cavity on the under side, formed by the frontal region folding back against the antennal. Here it appears small and pointed, and the lens, I presume, exists in the extremity beneath a semi-translucent cornea, protected and almost hidden by a mass of hairs.

The first pair of antennæ has the inner process of the first joint of the peduncle anteriorly pointed; the margin is but slightly curved upwards, thickly fringed with ciliated hairs and armed with two small teeth, as also is the outer margin, as well as that of the second and third joints; on the outer distal angle are two strong teeth, one before, the other behind the auditory fissure (fig. 3*c*). The under surface is at right angles with the inner, and is hollowed to receive the extremity of the phymacerite. The second joint is short and cylindrical, and the third, still shorter, supports one long and one short flagellum. The articuli of the inner flagellum are long and slender, and sparsely ciliated; those of the outer are short and thickly ciliated.

The second pair of antennæ has the first joint or coxa articulating freely with the metope, and on the under surface supports a long phymacerite, the extremity of which turns upwards and impinges against a depression on the inferior surface of the coxal joint of the first antenna. The orifice is therefore curved upwards, and is covered by a

thin chitinous membrane, which appears to be perforated by a small horse-shoe fissure, somewhat out of the centre, and unevenly surrounded by a ring of thickened tissue, that is probably muscular and therefore contractile (see fig. 13, p. 104). The length of the metope is small, and the organs that cover the mouth are produced anteriorly, so as to reach beyond the anterior margin of the carapace.

The cheiloglossa or anterior lip is thick and fleshy; in the centre, anteriorly directed, is a thin, flexible, styliform process, while the mass of the structure fills up and lies compactly in the hollow between the mandibles. The metastoma or posterior lip is likewise a thick and fleshy mass, internally and centrally produced to a small vertical process; externally and posteriorly the mass overlies the posterior portion of the psalisiform blades of the mandibles, and extends laterally in a slender digital process on each side, and lies in close contact with the mandibles, just where the psalisiform blades are connected with the apophyses. The mandibles consist of a pair of interlocking, scissor-like, serrate blades, differing very little from those in *Willemœsia* and *Polycheles*, carrying a two-jointed synaphipod, thickly fringed with hairs, and moved by a long and pointed apophysis, of which the extremity articulates with an underfold of the anterior surface of the carapace.

The first pair of siagnopoda consists of a double-branched appendage, curved, rigid, and fringed with stiff hairs that become spiniform at the apex of the outer and larger branch; on the external surface, near the base, there exists a fasciculus of short, thickly ciliated, slender hairs, springing apparently from a common centre.

The second pair of siagnopoda resembles that of other species; it consists of two short and small branches on one base, which fold back against a large, flat, foliaceous plate, that is produced anteriorly further than the two previous rami, and posteriorly to an equal extent, and is fringed with cilia that radiate in an anterior direction.

The third pair of siagnopoda corresponds with that of *Polycheles*, as shown at p. 135, fig. 32. It consists of three thin foliaceous branches; the basal one is short, broad, concave, and truncated, and has the margin fringed with hairs; the middle branch is narrow, and coincides with the curve of the inner margin of the third branch, the corresponding sides being smooth and free from hair, while the outer edge is thickly fringed with short, fine hairs. This and the preceding branch turn outwards and fold back against the next or distal joint, which is much longer and broader than either of the others; it is hollow internally, folding like a leaf upon itself, and this convolution increases considerably towards the apex, where it causes a cup-like appearance; at the outer margin a small bat-shaped flap, thickly and evenly fringed with hairs, is articulated, and acts like a movable valve at the exit of the branchial chamber; from the root or base of the three joints arises a broad, thin, and long membranous plate, the homotype of the mastigobranchia attached to the several pairs of pereiopoda, the epignathite of Milne-Edwards.

The first pair of gnathopoda is short and pediform, and consist of only six joints; the coxa and basis appear to be closely impacted, but not fused together; the ischium and meros are broad and flattened, the external margin forming a continuous arch, the internal exhibiting signs of an articulation between the two joints; the carpos is pear-shaped, and articulates at its smaller extremity with the external angle of the meros; it is furnished with strong, stiff hairs, all of which are fringed with short, stiff, sub-conical spines; the propodos appears to be fused with the dactylos, between which and it there is no definite articulation, but at the position where it normally exists, there are two large, strong, slightly curved spines on the outer surface, and one similar on the inner; the meros and ischium are similarly armed, but mostly on the inner margin.

Fig. 37.—Second gnathopod of *Stereomastis suhmi.*

The second pair of gnathopoda is as long again as the first, and has seven joints. The coxa is short and broad, supporting a rudimentary mastigobranchial plate (fig. 37), which is very minute, long-ovate in form, and attached to the coxa by a short pedicle; it is furnished with a few short, ciliated, stunted hairs; the basis is short and closely associated, if not fused, with the ischium; the ischium is long, flat, and slightly curved; the meros is narrower and shorter than the ischium; the carpos is one-third the length of the meros, and a little thinner; the propodos is about the same length as the carpos, and not broader; the dactylos is sharp and styliform. The entire limb is fringed with hairs of different forms: on the inner side of the propodos they are short and fur-like; on the inner side of the carpos they are longer and closely set, as they are on the meros, but still longer; on the outer side of the carpos and meros they are long, and fringed with small cilia that are perpendicular to the stalk; the ischium is fringed with a few long ciliated hairs on the outer side, and short, stiff ones on the inner.

Fig. 38.—First pereiopod of *Stereomastis suhmi.*

The first pair of pereiopoda carries no mastigobranchial appendage and only a small podobranchia (fig. 38), but attached to the coxo-pleural articulation are two very small and feeble plumes, the anterior and posterior arthrobranchia, but no pleurobranchia.

The second pair of pereiopoda has a podobranchia of tolerable size, attached to a calcified pedicle, that thins out as a central rib, furnished with a few hairs, but with no mastigobranchia; two larger arthrobranchiæ, and a short pleurobranchia, that is attached very near to the peduncles of the arthrobranchial plumes.

The third and fourth pairs of pereiopoda have podobranchiæ similarly formed to the preceding two arthrobranchiæ, and a pleurobranchia, which are longer than those of the

second. The posterior pair has only one long pleurobranchial plume, situated high within the chamber. The branchial apparatus may therefore be arranged as in the following table :—

Pleurobranchiæ,	.	.	.	...	...	...	1	1	1	1
Arthrobranchiæ,	.	.	.	...	...	2	2	2	2	...
Podobranchiæ,	.	.	.	...	...	1	1	1	1	...
Mastigobranchiæ,	.	.	.	...	r	...	...	...	...	...
				h	i	k	l	m	n	o

The plumes not only increase in number, but also in length, as they proceed posteriorly.

The fifth pair of pereiopoda has a very large coxal joint in the male, which approaches nearer to that on the opposite side than in the female, and is perforated by a large foramen, through which a flexile and probably erectile vas deferens projects (fig. 3*o*, ♂) at certain periods to a very considerable extent, and rests upon the broad concave surface of the first pair of pleopoda, which in the male is narrow at the base as far as the extremity of the first joint, forming a cylindrical stalk, whereas the second joint gradually thins out to a hollow, spatuliform plate, probably serving to support the long and membranous vas deferens in its relation to the female.

This appendage in the male, from its formation, is of much interest, inasmuch as its relation to the vas deferens shows the simplest form of the organ that in the Brachyura fulfils the duties of an intromittent organ. In the present instance the small size of the orifice in the coxa of the third pair of pereiopoda in the female precludes the idea of any connection between the sexes by intromission; but it appears certain, from the great length of the extended vas deferens in some specimens after death, that the extremity of the male organs are during connection brought into close proximity with the external aperture of those in the female.

On the ventral surface of the pereion of many specimens, especially females, I found a layer of thin, gelatinous, and transparent material. In some places it was of thicker substance, as if the centres of extending growth. Sparsely scattered through the mass were stellate spicules, which consisted of branches variously radiating from a single centre, forming a star with six or eight rays. Each ray slightly tapers towards the extremity until it bifurcates, and forms a series of small holes, varying in numbers from three to six, that externally surrounds a large central hollow.

Stereomastis auriculata, Spence Bate (Pl. XVI. figs. 3, 4).

Pentacheles auriculatus, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. ii. p. 280, 1878.
„ *auriculata* on Pl. XVI.

Carapace narrow; lateral margins subparallel, armed with five teeth on the anterior region, three on the median, and seven posterior to the cervical fossa. The anterior

margin is armed with a small tooth within the internal orbital angle, two rostral in the median line, behind which on the central dorsal ridge are successively three single teeth, then two, then a single one anterior to the cervical fossa, posterior to which are two on the margin and two a little behind, the rest of the ridge is smooth to the posterior margin, on each side of which is a small sharp tooth.

The armature may be tabulated as—

Marginal, ...	5—3—7
Dorsal crest, ...	2·1·1·1·2·1—2·2· ·2.

The pleon is carinated, and the first two somites are armed with small anteriorly-directed teeth; the third and fourth with large and sharp ones; the fifth has no tooth, but a small cusp; the sixth has a double baccated ridge that becomes confluent at the posterior margin, and the telson is furnished with a small central carina and two small ones on each side, a little posteriorly.

The first pair of pereiopoda has the carpos armed at the distal or propodal extremity with a small sharp tooth on the inner and outer angles; the meros is smooth on the inner margin and armed on the outer with a single small tooth near the external distal or carpal angle, and a second small solitary tooth, one-third distant from the ischial joint.

The posterior pair of pereiopoda is chelate, the pollex being shorter than the dactylos.

Length (male), 50 mm. (2 in.).

Habitat.—Station 174c, August 3, 1874; lat. 19° 7′ 50″ S., long. 178° 19′ 35″ E.; off Kandavu Island; depth, 610 fathoms; bottom, coral mud; bottom temperature, 39° One specimen.

Compared with others this species is narrow across the carapace. The teeth on the margins are slender and sharp; that on the anterior angle particularly so. The several divisions are clearly defined. The frontal margin is armed with four teeth between the orbits, the two central are rostral, and the one on the inner angle of the orbit is within the margin; posterior to the orbital notch is a row of three small sharp teeth situated diagonally between it and the median line; three other small teeth, two of which are not shown in the figure, stand in a triangle, the posterior being on that part of the ridge formed by the cervical fossa, where it bifurcates to form the median division, the second stands on this branch, and the third is anterior and internal to it. Twelve teeth, including the two anterior or rostral ones, traverse the central ridge of the carapace. The branchial region is defined by a waved ridge, armed with small teeth.

The first somite of the pleon is slightly narrower than the carapace; the dorsal portion is armed on the median line with a small sharp tooth directed forwards; the lateral extremity is armed with a tooth to the inner side of the peltecleis or shield-bolt

that projects from the carapace and overlaps the anterior margin of the first somite of the pleon, and another on the extremity of the somite, where it overlaps the posterior margin of the carapace.

The second somite is longer than the first, and has the anterior margin of the elevated portion armed with a small anteriorly-directed tooth.

The third and fourth somites are armed with dorsal teeth that are very large, sharp, and curved forwards; the coxal plates of these and of the second somite have on the surface an elevated curved line or ridge that somewhat resembles in form the outline of the human ear (fig. 4), from which its specific name is derived. The anterior margin of the coxal plate of the second somite is anteriorly produced to a point or cusp; posteriorly these plates diminish in size and become less round.

The fifth somite carries no tooth, but a small carina-like ridge. The sixth somite has neither ridge nor cusp, but a central depression, produced by a baccated ridge on each side of the median line, the two becoming confluent at the posterior margin somewhat as in *Polycheles euthrix*, *Polycheles helleri*, and *Polycheles baccata*. The telson has two small cusps in the median line.

The orbital notch (fig. 3C) has the inner and outer margins nearly parallel, and the ophthalmopod is armed on the anterior margin with an obtuse cusp; the lateral portion passes outwards beneath the antero-lateral projection of the carapace.

The first pair of antennæ has the squamiform process smooth on the inner margin and produced anteriorly to a sharp point; the outer margin near the anterior angle is armed with two sharp teeth, one before, the other behind the fissure that opens into the auditory chamber; the second joint is long, the third short and terminating in two unequal flagella, of which the inner is rather more than half the length of the carapace and the other is very slender and of about the same length as the peduncle.

The second pair of antennæ (fig. 3c, *c*) carries a long phymacerite that turns inwards and upwards, with its extremity lying in a depression in the under surface of the first joint of the first antennæ. The scaphocerite is slender and obtusely pointed.

The oral appendages have not been disturbed, but, so far as observation could be made, there is no reason to suppose any variation from the common character.

The second pair of gnathopoda supports a rudimentary mastigobranchia, but otherwise does not vary much from the common type.

The first pair of pereiopoda is delicate and generally free from armature, excepting one small tooth on the outer margin of the meros, at a little distance from the basisal articulation, another near the external distal angle of the same, and one on the inner and one on the outer angle of the propodal extremity of the carpos.

The other pairs of pereiopoda have the common typical form, except in the chelate character of the posterior pair. This appendage is shorter than the preceding, and

terminates in an unequal-fingered chela; the dactylos is long, but the pollex or terminal process of the propodos is scarcely half the length of the dactylos.

The mastigobranchiæ are absent from all the pereiopoda, and the podobranchiæ are attached to scale-like stalks; in other respects the several branchial plumes correspond with those of *Stereomastis suhmi*, and agree with the tabulation given for that species.

The first pair of pleopoda in our specimen, which is that of a male, is long, slender, delicate, and spatuliform, but not so broad as in most male forms of other species; the second and following pairs are biramose and foliaceous. The inner branch of the second pair carries two stylamblydes, one long and straight, terminating in an enlarged point, the other short and rudimentary; in all the other pairs the smaller or rudimentary stylamblys is absent.

Observations.—This species is one of considerable interest, since it offers a very great difference in the structure of some of its parts from others found associated with it in the same locality. It is usual for the male to carry two stylamblydes attached to the inner ramus of the second pair of pleopoda, but although in this species we have two, one of them is almost rudimentary, and all the other pleopoda have only one.

The first pair of pleopoda is very narrow, and its spatuliform character is much diminished; it is only by close observation it can be determined to be that of a male animal, a circumstance that is corroborated by an examination of the foramen on the coxa of the posterior pair of pereiopoda.

The second pair of gnathopoda has no mastigobranchia but only the rudimentary bulb of one. In all the pereiopoda the mastigobranchia is wanting as a free appendage, while from the squamous and ridged stalk the podobranchial plume is developed; but this, though sufficiently large in the third pair of pereiopoda, is smaller than the arthrobranchia. The condition of the branchiæ was such as to preclude a very close examination, the more so as the specimen is unique, and it was desirable not to injure it more than was absolutely necessary. I have no doubt that the general arrangement of the several branchial plumes corresponds with the table as shown in *Stereomastis suhmi*.

It was taken in the same locality as *Pentacheles gracilis* and *Pentacheles euthrix*, about 70 miles south-west of the Fiji Islands, at a depth of about three-quarters of a mile, and associated with *Penæus* and *Oplophorus*.

Willemœsia, Grote.

Willemœsia, Grote, Nature, vol. viii. p. 485, October 1873.
„ Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. ii. p. 276, October 1878; Rep. Brit. Assoc., 1878.
Deidamia, Willemoes-Suhm, Notes from the "Challenger," Nature, vol. viii. p. 51, 1873.

Carapace depressed, armed on the frontal margin with a single rostral tooth projecting obliquely upwards; lateral margins subparallel, anteriorly and posteriorly converging,

pleon slightly narrower than the carapace, median dorsal line carinated; ophthalmopoda rudimentary, not lodged in a notch in the dorsal surface of the carapace, but situated in the metope and not produced beneath the latero-anterior angle of the carapace.

First pair of antennæ having the first joint of the peduncle produced to a scale-like process, which, being laterally compressed against the corresponding margin of the opposite appendage, is forced upwards into a crest-like ridge. The two succeeding joints are cylindrical, and the last supports two very unequal flagella.

The second pair of antennæ carries a pointed, ovate scaphocerite and a long terminal flagellum. The mandible has a serrate margin to the psalisiform blade, and carries a biarticulate synaphipod, but no molar tubercle, or ridge. The first and second pairs of gnathopoda have no ecphysis, but the second pair carries a moderately long mastigobranchia.

The pereiopoda are all chelate in both sexes; the anterior pair is long and slender, the posterior short and moderately robust.

The pleopoda, excepting the first pair, which is modified according to sex, are biramose. The rhipidura is well developed, the outer rami being broad and strong; the telson triangular, tapering, and terminally pointed.

Geographical Distribution.—This genus has been taken in the Mediterranean Sea, in the middle of the North and South Atlantic Oceans, and in the Pacific at a distance of about 500 miles from the south-western coast of South America, at depths ranging from 1300 to 2000 fathoms. The chief structural features that separate the species in this genus from their congeners are the form and position of the ophthalmopoda.

Willemœsia leptodactyla (Pls. XVIII., XIX., XX.).

Willemœsia leptodactyla, Willemoes-Suhm, Trans. Linn. Soc. Lond., ser. 2, vol. i. p. 50; Sp. B., Rep. Brit. Assoc., 1878; Ann. and Mag. Nat. Hist., ser. 5, vol. ii. p. 280 and pp. 484–7, 1878.

Deidamia leptodactyla, Willemoes-Suhm, Notes from the "Challenger," pt. 2, Nature, vol. viii. p. 51, May 15, 1873.

The carapace has the lateral margins subparallel, slightly approximating anteriorly and posteriorly. The antero-lateral angles are produced anteriorly to a sharp tooth that reaches beyond the centre of the frontal margin. The frontal margin is furnished anteriorly with an obliquely-directed rostral tooth, on one side of which, within the inner angle of the orbital notch, is a small solitary tooth; beyond it the margin to the outer angle is smooth. The median dorsal ridge is armed with six or seven strong teeth anterior to the cervical fossa, and four or five posterior to it. The lateral margins are separated into

three divisions, of which the anterior is serrate with eight teeth, the middle with five, and the posterior with eighteen or twenty teeth. The armature may be tabulated as—

Marginal, ...	8—5—18
Dorsal ridge, ...	111211—2111

The pleon is carinated, and furnished on each somite with an anteriorly-directed tooth, of which those on the second, third, fourth, and fifth somites are the largest.

The first pair of pereiopoda is long and slender, smooth on the outer side of the meros, excepting the distal angle, where there are two small teeth; the inner margin is furnished with a number of small denticles; the carpos is slender, smooth on the inner side, but fringed with small denticles chiefly at the propodal extremity on the outer; the propodos is serrate on the outer margin, and armed with a strong, sharp, straight tooth on the inner surface of the pollex, one-third distant from the apex.

The succeeding pairs of pereiopoda are all chelate, but much shorter than the first.

Habitat.—Station 13, March 4, 1873; lat. 21° 38′ N., long. 44° 39′ W.; depth, 1900 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·8. Length (female) 75 mm. (3 in.).

Station 133, October 11, 1873; lat. 35° 41′ S., long. 20° 55′ W.; depth, 1900 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·4. Length (female) 75 mm. (3 in.).

Station 298, November 17, 1875; lat. 34° 7′ S., long. 73° 56′ W.; depth, 2225 fathoms; bottom, blue mud; bottom temperature, 35°·6. Length (female with ova) 75 mm. (3 in.).

Station 300, December 17, 1875; lat. 33° 42′ S., long. 78° 18′ W.; between Valparaiso and the Gulf of Penas; depth, 1375 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·5. Length (male), 110 mm. (4·5 in.).

In August 1881 Prof. Giglioli[1] recorded a specimen of this species from the west coast of Sardinia, at a depth of 3000 metres.

The dorsal surface of the carapace is depressed, nearly flat, and is minutely granulated; from the apex of each granule springs a small, stiff, slightly curved hair. Lines of elevation armed with small teeth traverse the post-lateral median line, and define the regions of the internal organs. The ridge which traverses the post-lateral dorsal surface of the pereion, and marks the internal boundary of the branchial chamber, is longitudinally armed with a number of small teeth, all of which are directed forwards. The ridge corresponding with the cervical fossa is smooth, and free from teeth; so also is its anterior lateral branch, while that which runs from the inner angle of the orbit posteriorly in a flexuous line commences in a small but sharp and strong tooth. The frontal and

[1] *Nature*, vol. xxiv. p. 358, 1881; *Ann. d. Sci. Nat.*, ser. 6, vol. xiii. p. 5.

latero-frontal margins are smooth except for a fringe of hairs similar to those that cover the carapace. Posterior to the cervical fossa are from eighteen to twenty-three teeth. The number of the marginal teeth in our specimens is not constant on both sides. In some there are twenty-one on one side and twenty-three on the other, but since there is more than one hiatus on the side with the less number, the greater is probably normal.

The pleon gradually narrows dorsally from the posterior margin of the carapace to the extremity of the telson; the central ridge is carinated, and each somite is armed with a well-formed and prominent tooth, the apex of which is at the anterior extremity of the posterior half of each somite, and is produced to a sharp point and directed forwards. The first somite is shorter and narrower than the others, and its coxal plate is reduced to a solid protuberance that is hollowed in the anterior margin to receive the peltecleis of the carapace, which, instead of projecting over the anterior margin of the first somite of the pleon, as in *Polycheles*, falls into a hollow, and so forms an articulating joint between it and the posterior margin of the carapace, as shown on Pl. XX. fig. 1. The articulation of all the succeeding somites with one another takes place by a tubercular process, which projects forwards from the anterior margin of each somite and fits into a depression in the posterior margin of the preceding. The articulation of the first somite with the carapace is well covered and protected by a thick brush of fine, short hairs; a row of similar hairs, but less densely placed, fringes the posterior edge of the carapace, and that of all the somites of the pleon. There is no orbital notch, but there is a slight emargination in the anterior margin of the carapace, and the ophthalmopoda, which are small and almost rudimentary, are not lodged in it as in *Polycheles* and *Pentacheles*, nor are they laterally produced and covered by the projecting antero-lateral angle of the carapace; they are armed on the anterior surface as shown at Pls. XIX. c, c″, c‴ *a*, and XX. c, *a*, with a small cusp or tooth, and lodged in the metope, above the antennæ Pl. XX. c, *a*.

The first pair of antennæ (Pl. XIX. *b*) has the first joint of the peduncle expanded on the inner side into a thin plate which is driven upwards by the pressure of the corresponding expansion on the opposite side into a crest, the margin of which is serrate with thin, spine-like teeth, and rounded off anteriorly; the outer portion is thick and distended, containing an internal auditory apparatus, which consists of a rounded calcified chamber (*a.c.*), flattened on the anterior and posterior surfaces, and connected with the walls by a calcified channel, that opens by a long, narrow, slit-like foramen, just behind the upper and anterior margin of this first joint, the surface of which is smooth and free from any tooth-like processes such as exist in all the species belonging to *Polycheles* and *Pentacheles*; the second and third joints are subcylindrical; the third is shorter than the second, and supports two flagella, of which the inner is tolerably robust, and about as long as the carapace; the outer is small and slender, being scarcely longer than the peduncle of the antennæ on which it stands.

The second pair of antennæ (*c*) carries a long, projecting phymacerite (*o*, *t*) that curves

upwards so that its orifice, which is protected by a thin membrane, rests against and is inserted into a depression or hollow in the lower side of the first joint of the peduncle of the first pair of antennæ; the second joint supports on the outer distal angle a long, narrow, and pointed scaphocerite fringed with long hairs; the fourth and fifth joints are cylindrical and subequal.

The mandibles (Pl. XVIII. *d*) are large and powerful organs, having a deeply serrate margin surrounding the hollowed or concave psalisiform blade, which is separated into three parts by a tooth between each that is larger and more prominent than the others. The upper and outer surfaces are flattened, and at the base a two-jointed synaphipod articulates, which generally lies folded within the hollow under the blade, and is covered with a brush of tolerably long hairs, with which probably it sweeps the contents of the mouth into position for manducation; at the base is a long and powerful apophysis, the internal or distal extremity of which is produced to a right angle, and strengthened by lateral attachment. This projecting process is united to the inner surface of the carapace with which it is connected by two calcified tendons, one of which is on the inner side, just beyond the psalisiform blade, and the other on the outer side, at the extremity of the apophysis: by the aid of these the siagnos or mandibles are opened and shut at will.

The first pair of siagnopoda (*e*) are small, two-branched, and offer no characteristic distinction from those of *Polycheles* or *Pentacheles*.

The second pair (*f*) consists of two small foliaceous rami, fringed with hairs; both articulate with and fold back upon a large foliaceous plate that is fringed with a closely packed row of soft, fine hairs. The mastigobranchia is broad posteriorly, and formed to act as an operculum for accelerating or decreasing the current of water in the branchial chamber.

The third pair of siagnopoda (*g*) consists of a long and foliaceous plate, its extremity extending so far forward as to reach beyond the metope; the extremity is longitudinally folded on itself, and forms a hollow cavity at the inferior angle of which a small triangular foliaceous plate articulates; this plate folds back and falls into the chamber formed by the involution of the larger plate, and thus acts as a movable valve, which during life is probably in constant play in the outgoing current from the branchial chamber, and which it controls. In the hollow formed by the curve of the preceding branch is a narrow and shorter one, lying in contact with its inner wall. The several margins of these foliaceous plates are fringed with a closely packed row of fine hairs; attached to the base, on the anterior surface, is a broad, flat, foliaceous plate, fringed with long hairs, and on the posterior margin is a long and broad mastigobranchial plate that projects back and falls within the anterior opening of the branchial chamber.

The first pair of gnathopoda (*h*) is short, and moderately robust. It consists of seven joints. The coxa is large and robust, and carries no ecphysis or branch of any kind;

neither does the basis, which is short, and closely associated with the meros, and has the inner margin fringed with four or five cusp-like teeth; the ischium is short, and armed with two short cusps on the inner margin; the meros is long, ovate; the carpos is curved and triangular; the propodos is narrower than the carpos, cylindrical, and continuous with the dactylos, but defined from it by a strong spine on the upper and one on the lower margin; the dactylos is sharp-pointed.

The second pair of gnathopoda (*i*)—represented relatively too small in the figure—is long and slender, being twice the length of the first pair. The coxa is broad, fringed along the upper margins with long ciliated hairs, and carries a slender mastigobranchia, fringed with ciliated hairs near the base, and throughout the rest of the surface with hairs in which the cilia are differentiated into small points; the basis is short, armed with three small cusps, and fringed with long ciliated hairs; the ischium is ovate, long, flat, and covered with long hairs fringed with cilia, which are longer on the posterior than on the anterior surface; the meros is long, ovate, but shorter than the ischium, and not quite so broad; the carpos is shorter and narrower than the meros; the propodos is rather shorter than the carpos, and cylindrical; the dactylos is as long as the propodos, and terminates in a styliform unguis, supported by a secondary one on the lower or concave margin. There is no branchial plume connected with this pair of appendages.

The first pair of pereiopoda (*k*) is long and slender, being about once and a half as long as the animal measuring from the rostrum to the extremity of the telson; the coxa is broad, and supports an ecphysis in the form of a mastigobranchial plate on a long stalk, and a short podobranchial plume attached to its outer or posterior margin; the basis is short, and carries no ecphysis, it articulates with the coxa, which is attached to the ischium; the ischium is long, slender, flattened and curved, gradually increasing in width as it proceeds from the basisal joint; the meros is flat and very long, being three times the length of the ischium, from the extremity of which it gradually widens, and then more gradually narrows to comparative tenuity; continuing so for some distance, it again gradually enlarges a little at the carpal extremity, where it is armed on the outer angle with two curved unequal teeth; the inner margin is straight and fringed with numerous small denticles, every third one of which is larger than the intermediate ones; the outer margin is wavy and smooth; the carpos is long and slender, very nearly as long as the meros, the margins are parallel from one extremity to the other, the inner is smooth but the outer is fringed with a few denticles and has its distal angle, where it widens for the purpose of articulation, furnished with a moderately strong tooth. There is a slight curve near the meros, which must prevent the appendage from being extended in a straight line; the propodos is long, and including the pollex, longer than the carpos; its sides are parallel, and the pollex is continuous with the inner margin of the palm, and armed with one straight, perpendicular tooth (*k''*) on the inner surface one-fourth from the

extremity; the outer margin is fringed with denticles that become more conspicuous towards the dactyloid extremity of the propodos, where they exist in two rows; the dactylos resembles the pollex reversed, the lateral or palmate margins approximating, and having the extremities curved to overlap each other, and there is no tooth on its inner margin. The inner margins of the dactylos and pollex are throughout fringed with a narrow row or series of upright plates of extreme tenuity, the sides of which overlap each other and form a delicate cutting edge.

The mastigobranchiæ attached to this pair of appendages (*k*) are short and of extreme tenuity from the base. Each is slightly longer than the coxa is wide; it widens increasingly and terminates in an obtuse point covered with hairs that are subspinose. The podobranchial plume (*k'''*) attached is a small and feeble structure, shorter than the mastigobranchia. One of the arthrobranchiæ is also rudimentary, consisting only of a few small branchial processes. The other is moderately developed.

The second pair of pereiopoda is very much shorter than the first, and has the several joints comparatively robust and flattened on the surface nearest the body, against which the ischium and meros lie arched beneath the lower margin of the carapace. The pollex and dactylos impinge against each other throughout their length, except the apices, which cross one another. The inner surfaces of the pollex and dactylos are fringed with a row of thin plates somewhat similar to those in the first pair, except that each plate is produced to a sharp point, which gives a serrate character to the structure. Most of the joints are fringed with rows of long hairs. This pair carries a mastigobranchia that supports a podobranchial plume, above which are two arthrobranchiæ and a pleurobranchia.

The third (Pl. XX. *m*) and fourth pairs of pereiopoda are smaller than the second, which they generally resemble, particularly in the form of their chelæ, except that the curved unguis at the extremities of the antagonising pollex and dactylos are longer, so that the apices meet or cross one another. These two pairs support branchial arrangements similar to the preceding.

The fifth pair of pereiopoda is shorter than either of the others, and lies directed posteriorly. It terminates in a small chela that is similar in both sexes, and does not support any branchial lash or plume, except a moderately developed pleurobranchia situated high up beneath the carapace. The general arrangement of the branchiæ may be tabulated as follows :—

Pleurobranchiæ,	...	...	...	1	1	1	1	
Arthrobranchiæ, posterior,	...	...	1	1	1	1	...	
Arthrobranchiæ, anterior,	...	...	1	1	1	1	...	
Podobranchiæ,	...	...	1	1	1	1	...	
Mastigobranchiæ,	...	1	1	1	1	1	...	
	h	i	k	l	m	n	o	

The first pair of pleopoda in the female is two-jointed, uni-branched, long, slender, and flat, with parallel sides, the margins being sparsely ciliated with hairs, and the

extremity terminating in an obtuse apex. That of the male (Pl. XIX. *p*) is also unibranched and biarticulate. The first joint is subcylindrical; the second is subcylindrical at the base, but gradually widens into a broad and thin spatuliform plate, that is strengthened by a rib longitudinally traversing the centre.

The second pair of pleopoda (*q*) is biarticulate; the first joint is long, the second biramose, and the inner branch carries a single stylamblys in the female and two in the male on the anterior pair, and one on each of the three following, on all of which a group of cincinnuli exists at the apex in both sexes, while the margins are fringed with a row of ciliated hairs particularly on the outer side. The posterior pair of pleopoda and the telson form a powerful and well-developed rhipidura, the outer rami of which are broad and rounded at the extremity, bear a tooth on the outer margin, and are strengthened with a longitudinal median rib, as also is the internal plate. The telson is triangular and pointed.

Observations.—A female which I have used for this description was taken in the middle of the North Atlantic Ocean, half-way between the western coast of Africa and the West Indies. A second was taken in the middle of the South Atlantic, near Tristan da Cunha, about the latitude of the Cape of Good Hope and Buenos Ayres; and a male of the same species was taken near the island of Juan Fernandez, off the south-western coast of South America, in the same latitude as that which was captured near Tristan da Cunha. With this last specimen were also taken a species of *Pentacheles* and a very fine male specimen (Pl. XIX. c) of a decided variety of *Willemœsia leptodactyla*. It is larger than the female of the type specimen, being quite 4·5 inches in length, and thus half an inch longer than the largest female taken, and 1·5 inch longer than the only other male captured, and which was taken in the same locality. The dorsal surface, instead of being granulated and furry, is covered with numerous small sharp points or denticles, that are most numerous and closely packed on the anterior half of the carapace, but larger and more important on the posterior. All the teeth on the carapace are more conspicuous, and there are ten on the anterior division of the lateral margin, eight on the middle, and twenty-four on the posterior. The frontal margin is more advanced, and the internal orbital angle armed with more conspicuous teeth. The median crest, formed by the approximation of the upturned inner margins of the scale-like processes of the first pair of antennæ, is armed with longer and more conspicuous teeth, and the hairs that fringe it in the type-specimen are wanting. In all other respects it agrees with the typical form, except, perhaps, in having the telson longer and more pointed, and the outer foliaceous plates of the rhipidura somewhat pointed at the extremity.

One of the specimens was taken about 130 miles distant from the coast of South America, off Valparaiso. It carried a great number of ova attached to its pleopoda, in a somewhat advanced stage of embryonic development; a circumstance that enabled

me to determine that the brephalos when it first leaves the ovum, is in the Megalopa stage, as shown in Pl. XX. fig. 2. The ophthalmopoda are clearly defined as well-developed lobes of conspicuous proportions, as are the two pairs of antennæ.

The mandibles are less conspicuous but distinguishable, and the pereiopoda are visible in their position on each side of the folded caudal extremity, which terminates in two rounded lobes, one on each side of a central excavation.

The ovum is about 1·5 mm. in diameter, and perfectly spherical, and not at all suggestive of *Amphion*, which genus Boas[1] thinks may probably be the young of *Willemœsia*.

Family Homaridæ.

Cephalon subcylindrical. Carapace anteriorly rostrated, posteriorly produced over the anterior half of the first somite, but not kept down by a pleocleis.

Pleon with somites dorsally overlapping each other.

Pereiopoda seven-jointed, anterior three pairs chelate, first pair largest. Rhipidura well-developed, outer ramus having a diæresis.

Mastigobranchiæ large, having a well-developed podobranchial plume attached to all the pereiopoda except the posterior pair.

This family consists of the following genera:—*Phoberus*, *Nephropsis*, *Nephrops*, *Homarus*.

Phoberus, A. Milne-Edwards.

Phoberus, A. Milne-Edwards, Ann. d. Sci. Nat. (Zool.), sér. 6, vol. ii. p. 45, 1881.

Carapace slightly compressed laterally, armed anteriorly with a long and narrow rostrum furnished with lateral teeth. Pleon laterally compressed, coxal plates deep. Rhipidura large and well-developed, outer ramus of the posterior pair of pleopoda having a well-marked diæresis. Telson quadrate, terminal angles slightly rounded off. Eyes small, close together, implanted on short rudimentary ophthalmopoda. First pair of antennæ short, supporting two long and slender subequal flagella. Second pair of antennæ supporting a large and well-developed scaphocerite, of which the outer margin is produced to an acute point.

First pair of pereiopoda long, slender, and chelate; second and third pairs also chelate, but slightly shorter and much more slender; fourth pair simple, styliform; the fifth not chelate, but a polliciform process is produced at the inner distal angle of the propodos.

Geographical Distribution.—The specimens in the Challenger collections were taken in the Papuan Seas. Others closely allied have been taken by Alexander Agassiz in the West Indies.

[1] *Zool. Anzeiger*, ii. pp. 256–258.

Phoberus tenuimanus, Spence Bate (Pls. XXI., XXII.).

Acanthacaris tenuimana,[1] on Pls. XXI., XXII.

Carapace about one-third the length of the animal, cylindrical, laterally compressed, with deep sides. Rostrum long, narrow, laterally compressed anteriorly, armed on the upper distal extremity with three short, stout teeth, and on the under surface with five or six others, elsewhere it is smooth, the median dorsal line being depressed or grooved, and the entire surface spinous, strongly marked on the lateral margin where there are several large teeth in pairs running back in line with the margins of the rostrum, and continued almost to the cervical fossa, which deeply divides the carapace near the centre of the dorsal surface. The entire carapace is covered with short, sharp, prickle-like teeth, coarser and sharper on the anterior and dorsal surface, and less so on the branchial and posterior regions.

The pleon is long, and with the telson is nearly twice the length of the carapace exclusive of the rostrum. The entire surface is spinous, and the coxal plates are well defined in their connections with their respective somites. The telson is a long, quadrate plate, narrowing slightly towards the extremity, which is fringed with fine hairs.

The ophthalmopoda are small and in close proximity with each other at their base.

The first pair of antennæ reaches beyond the extremity of the rostrum.

The second pair equals in length that of the entire animal, and supports a scaphocerite that is as long as the rostrum.

The first pair of pereiopoda is long, slender, and cylindrical; the propodos is not broader than the carpos and is continuous with it; the pollex and dactylos are subequally long, slender, and flattened, the inner or impinging margin of each being armed with long and short spine-like teeth.

The second pair of pereiopoda is chelate, long, and very slender, more slender than the first but not quite so long; the third pair is not so long, more slender than the first, rather stouter than the second, and chelate; the fourth pair is simple, and as long as the preceding; the fifth is shorter than the fourth, and has the inferior distal angle produced to a sharp polliciform point.

Length, including the rostrum, 203 mm. (8 in.).

Habitat.—Station 191, September 23, 1874; lat. 5° 41′ S., long. 134° 4′ 30″ E.; south of New Guinea; depth, 800 fathoms; bottom, green mud; bottom temperature, 39°·5. Taken associated with *Nephropsis orientalis*.

The entire surface of the animal is spinous, the spines consisting of short, sharp-pointed teeth, closely and evenly distributed both on the carapace and pleon, and larger

[1] This name was given and the plates printed off previous to M. A. Milne-Edward's description of the genus, above alluded to, being published.

on the former than on the latter, while more especially on the dorsal surface of the second and third somites they are diminished in size, most probably from friction; on the anterior portion of the carapace they increase in size in a little ridge on the median line, which is slightly represented posterior to the cervical fossa; this ridge is anteriorly lost in the rostrum, which is flattened and dorsally concave at the frontal margin, whence it narrows laterally and becomes subcylindrical and then elevated into a compressed rostrum (Pl. XXI. c). Anteriorly the rostrum is armed with three strong teeth above and six below; a smooth space intervenes, more especially on the upper surface, until posteriorly the margins diverge, when several strong teeth, of which the second is the largest, and all are much larger than those on the general surface, continue in two subparallel conspicuous rows nearly to the cervical fossa. On the carapace the spines or teeth point anteriorly, on the antero-lateral parts of the pleon they point outwards and downwards, and on the rhipidura and posterior somites of the pleon they point posteriorly.

The eyes (c. *a.a*) are very small, not larger than the diameter of the small ophthalmopoda on which they are supported. They are situated immediately beneath the rostrum, and have no orbit, although there is a depression on the upper surface of the first pair of antennæ similar to that which exists in those species in which the organ of vision is well developed.

The first pair of antennæ (c, *b*) consists of three subequally long joints and two short terminal flagella, which are subequal in length and a little longer than the peduncle; the inner flagellum is only very slightly stouter than the outer, and both are nearly free from cilia; the first joint of the peduncle is a little broader than the others, particularly at its base, where a small flat tubercular process projects on the outer surface, near which on the upper surface is a diagonal fissure, protected by cilia, that forms a passage to the auditory chamber, which is lined with numerous short, robust, ciliated hairs planted in rows, and contains a quantity of calcareous and silicious particles.

The second pair of antennæ (c, *c*) is large and robust at the base, and is implanted a little below and outside the first pair. The coxa or first joint articulates freely with the metope, and carries a short phymacerite directed obliquely inwards and downwards, anterior to which is a short, stout-based, sharp-pointed tooth; the second joint is produced to a sharp point on the outer side, and supports a large scaphocerite about one-third the length of the carapace, and has its outer margin slightly curved outwards, stout, and fringed on the under surface with a dense row of inwardly-directed short cilia; the extremity is produced to a short tooth-like point from whence the anterior and inner margins, fringed with long cilia, curve to the base; the upper surface is covered with short, sharp, anteriorly and obliquely directed spinules; the under is much smoother, but possesses more sparsely scattered spines; the third joint is long, dorsally and ventrally flattened, and fringed on the under side with a dense row of

moderately long cilia; the terminal joint is short and reaches to the extremity of the scaphocerite, and nearly as far as the distal extremity of the rostrum; the flagellum is slender and free from hairs, and is four or five times as long as the peduncle.

The metope is smooth, and terminates in a deep ante-oral ridge or epistoma. The mandibles (Pl. XXII. *d*) are large and powerful, have a serrate margin on the psalisiform blade, and support a triarticulate synaphipod, of which the terminal joint is broad and hirsute.

The first siagnopod (*e*) is three-branched, the two inner branches being foliaceous and of extreme tenuity, the first being fringed with soft cilia on the inner margin, and the second with short, stiff, tooth-like spines; the third branch is biarticulate, narrow, and cylindrical, fringed with hairs on each side, and supports a second joint, which is flexed and turned outwards. The whole is in close contact with the mandibles.

The second siagnopod (*f*) is large, broad, and foliaceous, consisting of three branches, two of which are longitudinally divided, and a broad mastigobranchial plate that reaches forwards as far as the other branches, and only a little behind the basal articulation.

The third siagnopod (*g*) is three-branched, and supports a long mastigobranchial plate. The first branch is broad, of great tenuity, foliaceous, and thickly fringed with cilia; the second is biarticulate, cylindrical, and fringed with cilia; the third branch consists of a long basal joint, fringed with many cilia on the outer margin only, and supports a multiarticulate flagellum. The mastigobranchial plate is long and tapering, the distal margin serrate, and the surface having numerous long fine hairs.

The first pair of gnathopoda (*h*) is six-jointed, the dactylos being absent or represented by several short, stout, tooth-like spines; the propodos is short and obtuse, the carpos broad, much more so than the propodos or meros; the ischium is long and broad, straight on the outer, and arched on the inner side, which is fringed with marginal hairs, and submarginal tufts of hairs; the basis carries an ecphysis, of which the extremity for more than half its length is multiarticulate; the mastigobranchial plate is long, tapering, and sparsely covered with long delicate hairs, and the podobranchia is short and small, less than one-third the length of the mastigobranchia.

The second pair of gnathopoda (*i*) is long and slender, more especially the three distal joints; the meros and ischium are broad, subequal in length, and armed on the inner side with a row of short obtuse teeth, mingled with numerous fine hairs; the basis supports a slender uni-articulate ecphysis, and the coxa carries a mastigobranchia with a long podobranchial plume.

The first pair of pereiopoda (Pl. XXI. *k*) is long, cylindrical, and chelate. The ischium is short, and articulates freely with the meros; the meros is long, and articulates freely with the carpos; the carpos is short, continuous, but with a slight articular movement with the propodos, which is cylindrical at the base, and becomes horizontally flattened

towards the distal extremity, where it is prolonged into a flat and narrow pollex that articulates with a similarly formed dactylos. The entire appendage is spinous, the spines being of a similar character to those on the body of the animal. They are larger on the upper and lower margins of the meros, the largest existing at the upper distal or carpal angle. A large tooth or spine exists on each side at the base of the dactylos. The dactylos is spinous on the inner and outer margins, having very regularly three short to one long tooth on the outer margin, and four or five short to one long one on the inner side; this is the case with the inner side of the pollex also, the outer side of which is smooth.

The second pair of pereiopoda is very slender, smooth, chelate, and cylindrical; the meros and carpos are subequally long, and the propodos is short.

The third pair is slightly spinous, much more so than either of the others, and more robust than the second; the carpos is shorter than the meros, but larger than the propodos.

The fourth pair is about the same length as the third; the five first joints are spinous; the propodos is slender, longer than the carpos, and smooth; the dactylos is slender and styliform; the meros is armed with a strong tooth at the upper distal angle.

The fifth pair resembles the fourth in most points, except that the propodos is still longer than the carpos, and has the inferior distal angle (*o*) produced to a point that resembles a short, obtuse pollex; the dactylos is fringed with hairs on the outer side.

Each of these pairs of appendages, except the posterior, carries a mastigobranchia and its corresponding podobranchial plume, and two arthrobranchiæ. The four posterior pairs carry, moreover, a corresponding pleurobranchial plume.

The branchiæ may be arranged according to the following table :—

Pleurobranchiæ,	...	...	...	1	1	1	1		
Arthrobranchiæ,	...	2	2	2	2	2	...		
Podobranchiæ,	1	1	1	1	1	1	...		
Mastigobranchiæ,	1	1	1	1	1	1	...		
	h	i	k	l	m	n	o		

The podobranchiæ and pleurobranchiæ are the largest, and the arthrobranchiæ are the least important; the four plumes correspond to each other according to the position shown in the diagram on Pl. XXII. The podobranchiæ (*pd. b.*) overlie the others, and the pleurobranchiæ (*pl. br.*) are below them; lying between them on each side, anteriorly (*ar. b.*) and posteriorly (*arth*), are the arthrobranchiæ, having but a single row of digital processes on the inner side, and these lie between the base of the podobranchia and the upper surface of the pleurobranchia; the outer surface of each is furnished with a number of closely-packed digital processes, the various parts being kept separate by numerous long and slender hairs attached to the base or stalk of the podobranchial plume, and also to the surface of the anterior and posterior mastigobranchiæ (*m. b.*) which divide and separate

the branchiæ that belong to one pair of limbs into a distinct compartment from those of the succeeding.

The first pair of pleopoda in the female (Pl. XXI. *p*) is very slender, uni-branched, and biarticulate.

The four succeeding pairs (*q*) are biramose, the branches narrow and flat, the inner one carrying a rudimentary stylamblys in a well-defined notch.

The posterior pair is biramose, both branches, broad and flat, form the outer plates of the rhipidura (z., v, v); they are spinous, more especially on the upper surface; each being armed with a sharp tooth on the outer distal angle, and the outer is divided by a diæresis, the anterior margin of which is minutely crenated.

Observations.—This animal in its details corresponds closely with *Nephrops*, from which it is separated chiefly by the immature character of the ophthalmopoda, the form of the chela of the first pair of pereiopoda, the compressed character of the rostrum, and the general spinous condition of the surface of the animal. It was taken at a depth of nearly a mile, associated with *Nephropsis orientalis*, with which I may have to compare it when writing of that species. In general form it closely approaches *Phoberus cæcus*, A. Milne-Edwards, which was taken in the same locality as *Nephropsis agassizii*.

Nephropsis, Wood-Mason.

Nephropsis, Wood-Mason, Journ. Asiat. Soc. Bengal, vol. xliii. pt. 2, 1873.

Carapace, not including the rostrum, rather more than half the length of the pleon, bisected by a deep cervical sulcus. Pleon dorsally smooth. Telson quadrate.

Ophthalmopoda small, situated close together beneath the rostrum.

First pair of antennæ furnished with two slender flagella; first joint of the peduncle without a stylocerite.

Second pair of antennæ without a scaphocerite.

Mandibles robust and furnished with a three-jointed synaphipod.

First pair of gnathopoda subpediform, seven-jointed, supporting a two-jointed basecphysis, as long as the appendage, and a mastigobranchia; on the rest a podobranchial plume.

The second pair of gnathopoda long, slender and pediform, carrying a small and delicate mastigobranchia and a large podobranchial plume.

The first pair of pereiopoda is large and chelate; the second slender and chelate, and the third slender and minutely chelate. The last two pairs are slender and simple.

The first pair of pleopoda is uni-branched and almost rudimentary; the others are long, slender and biramose.

The rhipidura is symmetrical, with broad and disc-shaped, foliaceous plates, the outer of which is marked with a diæresis.

This genus was first established to receive a species, *Nephropsis stewarti*, dredged by Mr. Wood-Mason, which that author, in the above work, as well as in the Ann. and Mag. Nat. Hist. (vol. xii. p. 60), described as the typical species, and was taken 25 miles off Ross Island, on the eastern coast of the Andamans. He says "That the specimen was really brought up from this great depth (260 to 300 fathoms) is certain from the unmistakable signs of crushing from contact with the lip of the dredge, from its position in the dredge-bag, and from its firmly adhering greenish coat, which appears to indicate that, like *Calocaris macandreæ*, it is a burrower."

Mr. Wood-Mason further adds that, "The discovery in these warm seas of a very near, the nearest ally, in fact, of so characteristic a cold-water species, remarkable though it is, will not appear so surprising when I mention that my Crustacean lived and burrowed in the mud of the sea-bed at a depth of nearly 300 fathoms, in a temperature certainly not exceeding 50° Fahr."

The Challenger's specimen was taken at a depth of 800 fathoms, a few leagues south of New Guinea, at a temperature of 39°·5, which represents some 10°·5 of temperature still lower.

The same naturalist further remarks that "One of the chief points of interest attaching to this new form lies in the loss of its organs of vision by disuse, as in *Calocaris macandreæ*, Bell, in *Cambarus pellucidus* (a member of the same family as that to which *Nephropsis* belongs), and in the other Crustaceans and animals inhabiting the caves of Carniola and Kentucky. I not only agree with Mr. Darwin in attributing the loss of the eyes to disuse, but I also regard the great length and delicacy of the antennæ, and the great development of the auditory organs, as modifications effected by natural selection."

It appears, both from Wood-Mason's own figures and from an examination of the Challenger specimens, that this genus cannot be described as being without organs of vision. That the ophthalmus does not occupy a greater space than the diameter of the peduncle, and the absence of the dark pigment that generally gives colour to the eye may be evidences of degradation; but I have little doubt that the power of vision is equal to the animal's requirement. The ophthalmopoda are slender, but in Mr. Wood-Mason's figure they are about one-fourth the length of the rostrum, that is, equal to the average length. In *Calocaris macandreæ*, to which he compares his species, the peduncle seems wanting, but the ophthalmus is figured by Bell as being quite equal in diameter to the eyes of similarly proportioned Crustacea, but the absence of colour prevents our readily detecting the form of the organ. In the genus *Alpheus* the peduncle of the eye is often shorter than in either *Calocaris* or *Nephropsis*, but since the organ is lined with black pigment no one would think of describing it as

sightless. And recently a young specimen of *Homarus* has been taken in the English Channel that corresponds with the description of *Nephropsis* in most points, except that it has well-developed organs of vision, and that the retina at the back of the lenses is lined with black pigment.

Geographical Distribution.—The Challenger brought home specimens of this genus from Bermuda and from the Papuan Seas.

Mr. Wood-Mason records his specimens from the Andaman Islands, in the Gulf of Bengal. The Rev. Dr. Norman has described a new species, *Nephropsis atlantica*,[1] with small and immature eyes, obtained by Mr. Murray in the Færöe Channel, during the cruise of the "Knight Errant" and of the "Triton."

But for the absence of the scaphocerite from the second pair of antennæ, I should be much inclined to believe that the species of this genus are only young forms of *Nephrops* or of some nearly allied genus. The specimen that I described as *Nephropsis cornubiensis*, in the report of the British Association for 1880, with the reservation, "but as we know so little of the young of any of the Macrura after they have passed the earliest stages, we are induced to believe it to be no other than an immature condition of *Nephrops*," I have recently been able to determine to be a stage in the development of *Homarus marinus* of the European Seas. Now, as *Nephropsis suhmi* was taken associated with *Phoberus tenuimanus*, at Station 191, it is not improbable that the two are the same species at different ages. The Rev. Dr. Norman in writing to me says, "The genus is certainly not the young of *Nephrops*. I have specimens of *Nephrops* of *very much* smaller size than the *Nephropsis*, and the pleon *though very like* is different." But it is remarkable that of all the specimens taken in the cruises of the "Knight Errant" and "Triton," there is no spawn on any.

The fossil genus *Hoploparia* is undoubtedly closely allied to this genus, and probably represented it in the ancient seas; for *Hoploparia belli*, as figured by Salter and Woodward in their Chart of Fossil Crustacea, and by Bell in his Fossil Malacostracous Crustacea, although of larger dimensions, is very closely related to, and probably is a direct ancestor of the recent species. Our specimens of the genus *Nephropsis* are certainly immature forms, if we may judge from the fact that the external sexual foramina are not appreciable, and we may consequently assume that the internal organs are not fully developed in their present state. All the specimens recorded have been taken at a great depth in the sea.

Nephropsis stewarti was taken at 300 fathoms, *Nephropsis suhmi* at 800 fathoms, *Nephropsis rosea* at 700 fathoms; the temperature ranging from 39°·5 to 50° Fahr. (Wood-Mason), *Nephropsis atlantica* was taken in great abundance in the Færöe Channel, North Atlantic, and *Nephropsis agassizii* in the West Indies.

[1] *Proc. Roy. Soc. Edin.*, vol. xi. p. 684, 1882.

Nephropsis rosea (Willemoes-Suhm, MS.), (Pl. XXIII. figs. 1, 2; Pl. XXIV. fig. 1).

Astacus rosea, Willemoes-Suhm, MS., Notes and Drawings made during the Expedition.

Carapace slightly granular. Rostrum about half the length of the carapace, armed with a strong tooth on each side near the middle, another at the base just above the eye, and a smaller one in a line behind the last-mentioned. First pair of pereiopoda armed with a small tooth on the lower distal angle of the meros, and another on the upper distal angle of the carpos. Coxal plates of the pleon infero-posteriorly terminating in a sharp point, the anterior margin of the first plate being slightly serrate, the others smooth.

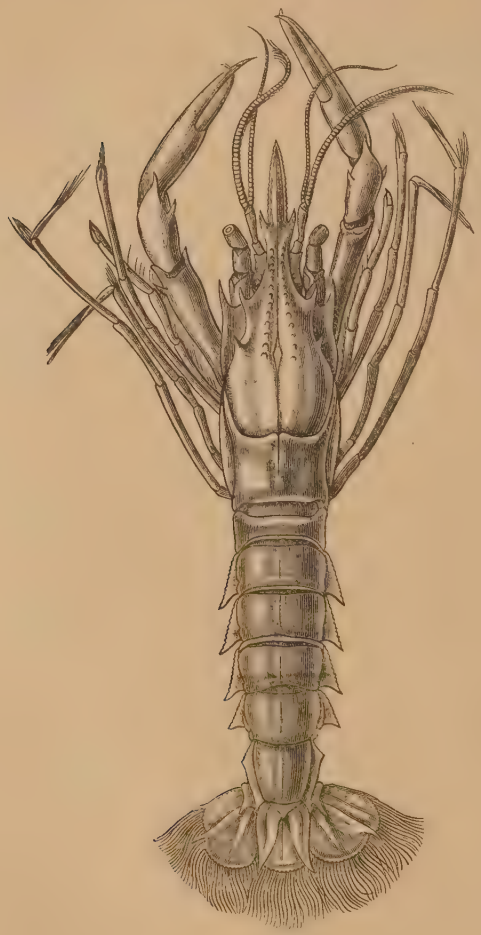

Fig. 39.—*Nephropsis rosea*. From a drawing by Willemoes-Suhm.

Length, 25 mm. (1 in.), one specimen (male).

Habitat.—Station 57, May 30, 1873; lat. 32° 11′ 7″ N., long, 65° 3′ 20″ W.; off Bermuda; depth, 690 fathoms.

Carapace granular; cervical sulcus well defined; rostrum long, wide, dorsally flat, narrowing to a sharp point anteriorly, arched posteriorly, depressed anteriorly, with the apex turned slightly upwards, armed on each side near the middle with a strong, long, sharp, anteriorly directed tooth, and on the continuous ridge posterior to the orbit, with one large, and behind it one small tooth. The orbital notch is flanked on the outer and lower sides with a long, simple, straight tooth.

The pleon is dorsally smooth, but granulated in texture, and has the coxal plates distinctly defined from the body of each somite.

The ophthalmopoda are small, and situated closely together beneath the rostrum, supporting a scarcely appreciable ophthalmus.

The first pair of antennæ (Pl. XXIV. *b*.) in the male consists of a peduncle which originates immediately on the outer side below the base of the ophthalmopoda, the first joint of which is excavated on the upper surface for the greater freedom of movement of the eye, and a blepharis or row of strong cilia fringes the upper and distal extremity of the excavated portion of the antenna, and forms a valuable protection to the visual

extremity of the ophthalmopod when at rest; the second joint is shorter than the first, and the third is as long as the two preceding put together, and bears at the extremity two long flagella, of which the inner is slender and thread-like, and the outer thicker and gradually increasing in size until near the extremity, when it rapidly decreases to a fine point; along the thicker portion the flagellum is fringed with membranous cilia.

The second pair of antennæ (*c*) in our unique specimen has the flagellum broken off at the extremity of the peduncle, which is tolerably robust and nearly as long as that of the first pair. The first or coxal joint articulates freely with the metope, supported on the outer side by a strong tooth; and supports a prominent and well-defined phymacerite.

The mandible (*d*) is large, having a smooth incisive plate, and a short, strong, three-jointed synaphipod.

The first pair of siagnopoda (Pl. XXIII. fig. 1*e*) consists of two single foliaceous plates, fringed on the inner distal margin with a double row of short, closely planted spines and a few short, stiff hairs within, both on the upper and under surfaces; also a group of longer ciliated hairs on the inner basal margin. The plate is articulated to a short joint, which from analogy I take to be the basis, on the outer side of which articulates an ecphysis, terminating in a flagelliform lash ending in two long, sweeping hairs. At the base of the branch is a small bundle of ciliated hairs.

The second pair of siagnopoda (fig. 1*f*) consists of three plates, besides the mastigobranchia; two are foliaceous, divided, and fringed on the inner distal margins with a thickly-set brush of hairs, some of which are stiff and simple, some ciliated, and some curved; the third plate is narrow and gradually tapers to a point, which turns slightly inwards and terminates in two or three long, simple hairs; the mastigobranchia is foliaceous, produced anteriorly as far as the extremity of the slender tapering ramus of the same appendage, and is fringed anteriorly with long ciliated hairs that are curved like a hook at the extremity, and posteriorly with a few that are much longer than the rest.

The third pair of siagnopoda (fig. 1*g*) has three branches and a mastigobranchia. The inner is foliaceous and fringed on the inner margin with a copious brush of thick hairs, and with a second row evenly arranged behind it on the outer surface: the middle branch is slender and biarticulate, fringed on the outer margin with a few stiff, simple hairs, and on the inner with others that are long and ciliated: the outer branch is also long and slender, half as long again as the middle; it is likewise divided into two parts: the basal is fringed on the outer margin with numerous short, ciliated hairs, the inner side is smooth; the distal division of the branch is multiarticulate, and terminates in a few long, simple hairs; the mastigobranchia is short, broad, and of extreme tenuity, sparsely protected by a few isolated simple hairs.

The first pair of gnathopoda (fig. 1*h*) is subpediform and seven-jointed; the coxa

supports a short mastigobranchia of great tenuity, fringed with long slender hairs; the basis carries a long ecphysis, the first joint of which reaches nearly to the extremity of the ischium, and terminates in a multiarticulate extremity that is tipped with one or two hairs, and reaches to the propodos; the ischium is short; the meros is long and somewhat narrowing to the carpos; the carpos, propodos, and dactylos are subequal, the propodos being somewhat the larger of the three, and is fringed on the inner and outer margins with long hairs, among which on the inner side are a few spines, armed with short, stout teeth; the dactylos terminates in four or five short, stiff, simple, spine-like hairs.

The second pair of gnathopoda (fig. 1*i*) is long, pediform, and seven-jointed. The coxa supports a short and delicate mastigobranchia, a podobranchial plume, and two arthrobranchiæ; the basis carries a slender ecphysis that is about half the length of the gnathopod, reaching to about the extremity of the meros; the first joint is single, long and slender, reaching to three parts the length of the ischium; the second is multiarticulate, and terminates in a few long hairs; the ischium is long and has its margins parallel, the inner being thickly fringed with long simple hairs, beneath which is a row of small cusps; the meros is shorter than the ischium, but is formed as a continuation of it, and the inner margin, which is smooth, has a fringe of long hairs; the carpos is about the same length as the meros, but is slightly more robust and fringed on the inner side with long hairs; the propodos is a little shorter than the carpos, and the dactylos is shorter than the propodos; both are fringed on the inner side with long slender hairs interspersed among which are others that are strong and fringed with spines.

The first pair of pereiopoda is long, moderately robust, and chelate. The coxa is short, and supports a mastigobranchia, a podobranchia, and two arthrobranchiæ, all of which are very short and delicate; the basis is small, and visible only on the inner and lower surfaces; the ischium is robust and short, and articulates continuously with the meros, which has the outer and inner margins nearly parallel, the surface is granulated with small tubercles and armed with a strong tooth on the upper and lower angles of the distal extremity; the carpos is about half the length of the meros, and is armed at the upper distal angle with a sharp anteriorly-pointed tooth; the propodos is long and narrow; and the pollex, which is half the length of the palm, is about the same length as the dactylos, and antagonises it throughout its entire length, the apices overlapping each other.

The second pair of pereiopoda is more slender and feeble, and about a third shorter than the first. The coxa supports a small mastigobranchia, a podobranchia, and two arthrobranchiæ; the basis, unlike that of the first pair, forms a distinct but short joint; the ischium is considerably longer though still short, and the meros is three times its length; the carpos is long and slender; the propodos is longer than the carpos, and has its margins parallel, the lower being produced anteriorly into a sharp, straight pollex,

which corresponds with a dactylos of its own length; the three posterior pairs of pereiopoda are long and slender, the dactylos remarkably so, and fringed with a few long hairs; the antepenultimate and penultimate pairs support each a podobranchia, mastigobranchia, and two arthrobranchiæ, but the posterior pair has none.

The first pair of pleopoda (Pl. XXIV. *p*) is situated near the ventral median line, and consists of two joints rigidly connected and directed forwards.

The second pair (*q*) is attached to the inner side of the posterior margin of the coxal plate, and consists of a long basal joint carrying a pair of long, flattened, narrow branches, fringed with long ciliated hairs, the inner branch being furnished with a long, cylindrical, slender stylamblys, armed with a few obtuse hooks at the apex.

The three following pairs of pleopoda are similarly formed, but the stylamblys becomes gradually more slender in each successive pair.

The ultimate pair of pleopoda has a short basal joint carrying the two large, squamous plates of the tail-fan, the outer one having a diæresis which divides the plate near the middle, and both are armed on the outer side by a strong, sharp, posteriorly-directed tooth.

The telson is long, quadrate, with the sides subparallel, terminating in two sharp spines, which are continuous with two strong ridges that begin at the base near the median line; the posterior margin is thin, convex, and fringed with long simple hairs.

Nephropsis agassizii, A. Milne-Edwards,[1] is probably this species.

Nephropsis suhmi, n. sp. (Pl. XXIII. fig. 3; Pl. XXIV. fig. 2).

Carapace coarsely granulated. Rostrum more than half the length of the carapace, armed on each side with two large and seven small teeth, also one on each side of the base and one on the antennal region.

First pair of pereiopoda having three teeth on the upper distal margin of the meros and one on the lower; carpos armed at the distal extremity with one large tooth above and one below. Pleon, having the coxal plates produced to a point, the anterior margin being furnished with a small point or sharp cusp.

Length 38 mm. (1·5 in.); sex undetermined; associated with *Phoberus tenuimanus*.

Habitat.—Station 191, Sept. 23, 1874; lat. 5° 41′ S., long. 134° 4′ 30″ E.; off Dobba, Arrou Island; depth, 800 fathoms; bottom, green mud; bottom temperature, 39°·5.

The carapace, from the posterior margin to the extremity of the rostrum, is rather longer than the posterior division of the animal. Rostrum two-thirds as long as the

[1] *Ann. d. Sci. Nat.* (Zool.), sér. 6, vol. ix. p. 124, 1879.

carapace, armed on each side with two long teeth, and with a row of smaller ones that diverge and terminate over the gastric region. A prominent tooth is placed above the orbit, and another above the infero-anterior angle of the carapace, and the general surface is slightly papillose.

The pleon is scarcely as long as the carapace including the rostrum, it is dorsally smooth, and the coxal plates are produced to a sharp point, the anterior margin of each of the four anterior being armed with a sharp tooth near the base. The eyes are small and immature.

The first pair of antennæ has the peduncle half the length of the rostrum, and the flagella reaching about half as far beyond it: the first joint of the peduncle or coxa has an enlargement on the upper and outer surface enclosing the auditory apparatus.

The second pair of antennæ has lost the flagellum,[1] the peduncle is as long as that of the first pair, and articulates with, but is not anchylosed to the metope. The coxal joint is short and carries on the inferior surface a phymacerite, which is formed by a prolongation of the external tissue, and has its apex covered by a thin membrane, in which an elongated perforation exists; the succeeding joints, which form the peduncle, reach to the extremity of that of the first pair, or to about the middle of the rostrum, or as far as the anterior pair of teeth on its upper surface.

The siagnos, or mandible, has a smooth, cutting margin, and a strong molar ridge, and in the hollow between the two ridges the three-jointed synaphipod lies when at rest; the distal joint of the latter is the longest, and is fringed on the outer margin with short, strong, bristle-like hairs.

The first pair of siagnopoda (Pl. XXIII. fig. 3*e*) consists of two small foliaceous plates fringed on the distal margin with short, stiff, spine-like hairs, and on the inner margin with a few longer that are ciliated, and a robust basecphysis terminating in a long reversed lash, which probably ends in two long sweeping hairs, but the part is broken in our unique specimen; at the base of this branch is a large fasciculus of ciliated hairs. This appendage differs from the same in *Nephropsis rosea* in having the large foliaceous plate broader at the distal extremity, and the basecphysis less slender and fringed with fewer hairs, but has a larger fasciculus at the base externally.

The second pair resembles that of *Nephropsis rosea*, but has the several foliaceous rami slightly broader, and the mastigobranchia produced somewhat more posteriorly.

The third pair closely resembles that of *Nephropsis rosea*, and so also does the first and second pairs of gnathopoda.

The first pair of pereiopoda is somewhat more slender, and has the dactylos and

[1] Dr. v. Willemoes-Suhm remarks in his notes on this species, "Also with this well-preserved specimen, every trace of the outer antennal lash is wanting, as in the specimen from Bermuda, so that I must now suppose that they are normally wanting;" an opinion which we cannot accept, as Mr. Wood-Mason has figured it in his species of *Nephropsis stewarti*, and it exists in the North Atlantic species.

pollex longer, and the apices pass more conspicuously beyond each other when closed. The carpos is armed above and below with a long, slightly bent tooth; so also is the meros, which has also two smaller ones on the upper margin.

The second pair of pereiopoda is long, slender, and feeble, and terminates in a small chelate extremity, of which the carpos and propodos are subequally long and wide, having the upper and lower margins parallel throughout; the dactylos is short, bends upon, and when closed impinges against the pollex, or digital prolongation of the propodos, throughout their entire length.

The two posterior pairs of pereiopoda are subequally long, and terminate in long styliform dactyli.

The branchial arrangement appears to be similar to that of *Nephropsis rosea*, and may be thus tabulated :—

Pleurobranchiæ,	...	...	...	1	1	1	1		
Arthrobranchiæ,	...	...	2	2	2	2	...		
Podobranchiæ,	...	1	1	1	1	1	...		
Mastigobranchiæ,	1	1	1	1	1	1	...		
	h	i	k	l	m	n	o		

The first pair of pleopoda is short and rudimentary, but I am not sure whether this be the permanent state, or only an immature sexual condition, as I have failed to determine whether the specimen be a male or a female. I closely examined the coxæ of the third and fifth pairs of pereiopoda, but failed to find a foramen in either. The central position of the rudimentary first pair of pleopoda, together with the occurrence of cincinnuli or small hooklets attached to the long stylus of the second and succeeding pairs of pleopoda, the narrowness of the ventral surface of the pereion, and the large diameter of the primary branch of the flagella of the first antennæ, without being conclusive, suggest its being a male.

The sixth or posterior pair of pleopoda (Pl. XXIV. fig. 2z) are broad and foliaceous plates, the outer being armed with a short strong tooth at about half the distance between the base and the distal extremity of the terminal margin, but having no distinct diæresis or joint dividing the plate. The inner plate is likewise armed with a sharp tooth, longer than that on the outer plate, and nearer the extremity of the terminal margin, which in both plates is furnished with a fringe of long simple hairs.

The telson is long and quadrate, the sides slightly waved and reversely conformable; the posterior margin is rounded and fringed with long, simple hairs, and is separated from the lateral margins by a strong, sharp tooth.

Nephrops, Leach.

The anatomical characters of *Nephrops* almost coincide with those of the genus *Homarus*, and but for the great dissimilarity of form of the first pair of pereiopoda, the two genera would probably be classified as being only specifically separate.

The branchial arrangement is identical, the structure of *Nephrops* approximating to that of *Homarus* more nearly than to that of *Nephropsis*.

Development.—The brephalos of the species of this genus has hitherto escaped observation; but a short time since Professor Sars[1] captured what he considers to be the "second larval" stage of *Nephrops norvegicus*, L., about 8 mm. long, and a second form but little larger, 11 mm., that of a "young *Nephrops*," in its "first postlarval stage."

Of the latter specimen there can be no hesitation in accepting Professor Sars's diagnosis, and if the former should, by observation of the brephalos direct from the ovum, demonstrate the correctness of this also, we shall find the apparently universal plan of development in the Astacidea modified by a new arrangement in the middle of the tribe.

Assuming that Phyllosoma is only a peculiar form of Megalopa, the young of *Nephrops* as shown by Sars is an intermediate form between the two. Thus we find that a modified condition of the Megalopa stage characterises the brephalos of all the families of the Trichobranchiata as far as is known, excepting the genus *Spongicola*, in which it is hatched in the Zoea condition.

The discovery of Professor Sars is undoubtedly one of considerable interest, as hitherto the development of *Nephrops* has been unknown. I have long been making efforts to get possession of specimens carrying ova in an advanced condition, but in a large number that I have received from the Rev. Dr. Haughton and others, there was not a female so laden. Nor were there any attached to those of *Nephrops thomsoni*.

There are one or two points in Professor Sars's specimen that require notice.

First, in general appearance it bears a resemblance to that form which we have considered to be a stage in the development of *Aristeus*, figures of which may be seen on Pls. XLVI. and XLVII. of this Report.

Secondly, it is noticeable for having the appendages of the cephalon and pereion in an advanced stage of development.

Thirdly, the several pairs of pleopoda are as yet only in the bud condition, and the rhipidura does not exhibit any evidence of being present.

Fourthly, the telson is formed on the type of that in the Brachyura rather than on that of the Macrura.

It is remarkable that animals so nearly allied as *Nephrops* and *Homarus* should exhibit

[1] *Archiv f. Mathem. og Naturvidensk.*, p. 159, pl. i., Christiania, 1884.

a development so different. A parallel case, however, is to be found in the Alphæidæ, in species so closely resembling each other in adult characters as to be scarcely distinguishable, and yet producing the brephalos in the separate forms of a Zoea and a Megalopa.

Geographical Distribution.—Hitherto there has been only one species of *Nephrops* known, and that appears to be confined to the northern European seas from the Irish coast to the shores of Scandinavia. Milne-Edwards adds the Adriatic, but I know no other authority for the Mediterranean habitat. Our new species, *Nephrops thomsoni*, was taken, the male near the Philippine Islands, the female near New Zealand; so that it appears to have a tropical and subtropical range in the Pacific and Indian seas.

The genus appears to be represented geologically, according to Milne-Edwards, by *Astacus leachii*, Mantell.[1] It agrees closely with some forms of *Hoploparia*, while others approach that of *Homarus*, most of which come from the Green Sand and from the London clay-beds.

Nephrops thomsoni, n. sp. (Pls. XXV., XXVI.).

Carapace produced anteriorly to a long sharp-pointed rostrum, the margins of which are dentate and continued in a ridge nearly to the cervical fossa. Antennal tooth very large and strong. First pair of pereiopoda long, slender and subcylindrical; carpos having two or three teeth on the outer and one on the inner distal margin; meros armed with one outer and one inner tooth on the distal extremity. The two succeeding pereiopoda are short and very slender and terminate in small chelæ; the two posterior have the dactylos long and styliform. The outer ramus of the rhipidura has a delicately crenated diæresis. Telson quadrate.

Habitat.—Station 166, June 23, 1874; lat. 38° 50′ S., long. 169° 20′ E.; between Australia and New Zealand; depth, 275 fathoms; bottom, Globigerina ooze; bottom temperature, 50°·8.

Length (female) including rostrum, 138 mm. (5·5 in.).

Station 204A, November 2, 1874; lat. 12° 43′ N., long. 122° 9′ E.; between Samboangan and Manila; depth, 100 fathoms; bottom, green mud; temperature not recorded.

Length (male), 125 mm. (5 in.).

The carapace from the frontal margin is one-third of the length of the animal. The rostrum is half as long as the carapace, sharply pointed and slightly elevated anteriorly, armed with one strong anteriorly-directed acute tooth on the under surface, midway between the eyes and the apex, also with two similar teeth on each side on the upper surface anterior to the eyes, from which a strong ridge passes backwards on each side to near the cervical sulcus or the posterior extremity of the gastric region of the cara-

[1] Geol. of Sussex, p. 221, pl. xxix. figs. 1, 4, 5, ; *Clytia leachi*, Reuss, *Denkschr. d. k. Akad. Wiss. Wien*, Bd. vi. t. 5, 1854. Restored in Salter and Woodward's Chart of Fossil Crustacea, 1865.

pace. On this ridge, on each side of the base of the rostrum, is a very large and acute tooth directed anteriorly and outwards; behind which on the same ridge are two other sharp teeth that decrease in size posteriorly; behind the last tooth the ridge fades away. Between the two ridges over the gastric region is a central but less prominent elevation, which commences posterior to the base of the rostrum and terminates a little in advance of the cervical depression. On the frontal margin, beyond the outer angle of the orbit, is a strong sharp tooth, directed anteriorly as far as the base of the scaphocerite; its outer margin is thick and strong, and extends back as a prominent ridge to the anterior or hepatic sulcus. In the depression between the ridge formed by this large tooth and the dorsal carinæ are two small teeth, one immediately behind the orbit, the other obliquely posterior to it, and about half way between the two ridges. On the region bounded by the hepatic sulcus and the cervical groove, somewhat below the line of the great antennal tooth, is a small sharp tooth directed forwards and outwards between which and the dorsal carinæ are four or five small teeth standing equidistant from each other on the posterior margin of the hepatic sulcus; these gradually increase in size as far as the place where the sulcus fades away (Pl. XXVI. fig. 1).

The posterior half of the carapace comprises the cardiac and branchial regions and possesses traces of three or four semi-obliterated carinæ, each of which is defined anteriorly by a small sharp tooth, and traversed by a series of granulations that are of the same character as those that stud the branchial region, but larger. The median carina is double, and appears to be an imperfect continuation of the small central ridge on the median line of the anterior half of the carapace. It is furnished just behind the cervical sulcus with two anteriorly-directed sharp teeth, and four or five other less important ones in pairs, some of which are sharp, and others like small tubercles, and they continue almost to the posterior margin, which is bordered by a broad, flat, but elevated band that traverses the posterior and infero-lateral margins of the carapace to near the anterior extremity of the branchial region, gradually fading away as it extends forwards.

The first somite of the pleon is narrow, not reaching beyond, or even quite to, the second lateral carinal ridge of the carapace; the anterior half, when the animal is extended, underlies the carapace, while the posterior half is slightly more elevated throughout, and overlies the posterior margin of the carapace laterally, producing the pleocleis, which keeps down and secures the carapace in position.

The second somite is longer and broader than the first. The dorsal surface is divided into two portions. The anterior, when the animal is completely extended, underlies to half its extent the first somite; the posterior overlies the anterior portion of the next succeeding somite, and is divided by two narrow and deep sulcis that commence near the median line on each side, and runs obliquely to the postero-lateral angle, leaving a smooth division between them. The coxal plate, although fused with the true somite,

is distinctly defined and distinguishable from it. It is advanced over the postero-lateral angle of the corresponding plate of the first somite, where it is elevated into a tuberculose enlargement, from whence the margin slightly advances anteriorly, and then gradually and smoothly rounds to the postero-inferior angle, which terminates in a sharp, projecting, posteriorly oblique point. The plate has a central depression corresponding in form to that of the outer margin.

The third, fourth, and fifth somites resemble the second, being but slightly modified to correspond to the varying curvature of the animal in flexion. The dorsal sulcus of the posterior division gradually decreases in importance, and in each the anterior margin of the coxal plates, instead of overlapping the posterior margin of the preceding as in the second, underlies it. The coxal plates, moreover, become successively narrower and shorter, and all are fringed on the internal surface of the margin with long, plumose hairs directed inwards.

The sixth somite (Pl. XXV. fig. 3) is modified more than any of the preceding, to support its appendages as a portion of the rhipidura. The dorsal sulcus has entirely disappeared, and the posterior margin is centrally elevated into a minute carina, terminating in a tooth, and the lateral ridge that defines the separation between the true somite and the coxal plate is armed near the centre with a sharp posteriorly-directed tooth. The coxal plate has an anterior and a posterior angle; the former is obtusely pointed and directed downwards, the latter acute and posteriorly directed, and the space between the two is concave to receive the basal joint of the posterior pleopod when folded.

The large and reniform eyes are supported on a small and short peduncle that originates beneath the rostrum, and therefore in close contiguity to the corresponding appendage on the opposite side. The organ rests in a cavity formed by the orbital notch in the anterior margin of the carapace, by a slight hollow on the inferior side of the rostrum, and by a deep depression formed on the upper surface of the first joint of the anterior antennæ, and a slight corresponding one on the second joint of the second antennæ; it is protected by a blepharis or fringe of hairs that traverses the orbital notch of the carapace, the infero-lateral margin of the rostrum, and the upper distal surface of the first joint of the first antenna.

The first antenna has the peduncle shorter than the rostrum. The first joint is long, convex beneath, where it is armed with a sharp tooth at the inner distal angle, it is depressed on the upper surface, being somewhat concave to admit the eye, and has near its base a small, rounded, squamous expansion, furnished with cilia forming a row continuous with that which fringes the outer margin of this and the two succeeding joints; the second joint is subcylindrical, and is scarcely one-third the length of the first; and the third is about half the length of the first; the last two joints are thickly fringed with short plumose hairs on the lower angle of the inner margin; the third joint supports at its extremity two subequal filamentous appendages, which are twice

and a half as long as their peduncle; the outer is rather the more robust, and both are entirely free from hairs or cilia of any kind.

The second antenna has the peduncle reaching beyond that of the first, but not quite to the extremity of the rostrum, and the flagellum is longer than the entire length of the animal from the extremity of the rostrum to the posterior margin of the telson. The first joint of the peduncle is short and broad, and supports a not very prominent phymacerite, the aperture of which is directed anteriorly, and protected by a small but strong calcified ridge; the second joint is also broad, armed at the outer distal extremity with a short, sharp tooth, and supports at its extremity a scaphocerite, which is scarcely longer than broad, rounded on the inner margin, which is fringed with small, thickly-set, ciliated hairs, and straight on the outer, where it terminates in a short tooth; the third joint articulates with the second obliquely-longitudinally on the inner side for about one-half its length, the other half articulates reversely in a similar manner with the inner side of the fourth joint, and is armed with a small, sharp tooth on the under side; the fourth joint is subconical in form, having the smaller end towards the base, where it articulates with the second and third joints, the former at the centre, the latter obliquely on the inner side; the fifth joint is not so long as the fourth, and scarcely longer than broad; the outer side is rounded, while the inner is compressed to a carina-like margin, fringed with a row of thickly ciliated hairs, which commences at the distal extremity, beneath a short, broad-based, sharply pointed tooth, and continues along the inner margin to near the basal extremity of the third joint. At the extremity of the fifth joint the long, somewhat compressed flagellum is articulated.

The siagnos or mandibles (Pl. XXVI. *d*) are smooth, concavo-convex, spoon-shaped appendages, with a molar ridge traversing the base of the internal surface; into the hollow formed by it and the anterior incisive margin a three-jointed synaphipod folds. Posterior to the mandibles the metastoma (posterior lip) exists in the form of a double-lobed appendage; from the inner side of each a strong and firm process arises, that folds round the posterior surface of the mandible.

The first pair of siagnopoda (*e*) is small, and consists of two foliaceous plates, fringed on the distal extremity with small blunt spines, and laterally bearing a two-jointed, slender appendage.

The second pair (*f*) consists of four foliaceous plates, fringed with short fur-like hairs, and a broad, distended, foliaceous mastigobranchial plate, divided into an anterior and a posterior portion.

The third pair of siagnopoda (*g*) is formed of two foliaceous plates fringed with hair, a reduced flagelliform appendage, and a long mastigobranchia, fringed with minute hairs and short, sharp, spinules.

The first pair of gnathopoda (*h*) is subpediform, and consists of seven joints. The coxa carries a mastigobranchia sparsely covered with fine, long hairs, and at the base a

bundle of branchial filaments, the rudimentary podobranchial plume; the basis is short, and carries an unbranched ecphysis, rudimentary in its character, and fringed with short hairs; the ischium is short and triangulate; the meros is very long, with the margins subparallel, approaching each other a little towards the distal extremity; the carpos is short and flat, narrow at the base, expanding distally, in the central depression of the extremity it articulates with the propodos, which expands in a similar manner, and similarly supports the dactylos, which is broad and spatuliform, and terminates in a blunt point, and like the preceding, is fringed with a brush of hairs.

The second pair of gnathopoda (*i*) is rather more pediform than the first, and consists of seven joints, the dactylos being styliform. The coxa supports a mastigobranchia that is broader, but scarcely longer than that of the first gnathopod, but instead of a small fasciculus of branchial filaments, the bundle is developed into a well-formed but not large branchial plume.

The first pair of pereiopoda is subequal in size and uniform in shape, that on the right side being very slightly larger, and the small tubercles that adorn the inner and lower surfaces are a little more conspicuous. The coxa is short, and articulates freely with the somite; the basis is short, and articulates freely with the coxa, but is fused with the ischium, which is moderately long and on the inferior side produced obliquely, beyond that of the upper surface; the meros is long, articulating laterally with the ischium, rounded on the outer, but flattened on the inner side, and widens towards the distal extremity, where it is armed with three large teeth, one on the lower, one on the inner and upper, and one on the outer angle, which last assists in forming the socket of the joint for the articulation of the carpos; the carpos is about half the length of the meros, it is nearly cylindrical, and armed on the outer surface near the centre with a sharp, strong tooth, one on the upper, and another on the inner distal angle; the propodos is long, compressed, with the outer margin smooth and the inner minutely tuberculated, near the centre of which is a short, sharp tooth, more pronounced on the left than on the right appendage from the smaller and less conspicuous character of the tubercular granulations.

The dactylos and pollex are very nearly as long as the palm in the male and a little longer in the female; they are smooth and continuous in a straight line with the joint on the outer surface, and fringed on the inner with two rows of closely-packed, short, plumose hairs; near the centre of the lower row stands a solitary, obtuse, strong tooth; another small one is situated at the anterior extremity of the same row of hairs, beyond which the tip suddenly curves to meet a similar opposing bend at the end of the dactylos, which is of the same length, and lies parallel to it, and is armed on the inner surface with a row of uneven, small, cusp-like teeth, forming a ridge that bites between the two rows of hairs on the pollex.

The second pair of pereiopoda does not reach beyond the carpos of the first. It is

slender, feeble, and chelate. Like all the others except the first, there is a distinct articulation between the basis and ischium.

The third pair resembles the second in size and form, while the fourth and fifth correspond in size, but differ from the preceding in not being chelate, and in having a long, simple dactylos, while the distal extremity of the propodos is furnished on the inner side with a fasciculus of short hairs.

The branchiæ are similar to those of the European *Nephrops norvegicus*, as shown in the accompanying formula :—

Pleurobranchiæ,	.	.	...	...	...	1	1	1	1
Arthrobranchiæ,	.	.	...	2	2	2	2	2	...
Podobranchiæ,	.	.	...	1	1	1	1	1	...
Mastigobranchiæ,	.	.	1	1	1	1	1	1	...
			h	i	k	l	m	n	o

In *Nephrops thomsoni* the podobranchiæ are smaller plumes than the pleurobranchiæ, and less than their homologues in *Nephrops norvegicus*.

The first pair of pleopoda (*p*) in the male is peculiarly modified for its requirements. It articulates with the ventral surface of the somite, considerably within the line of the posterior pairs, but this is probably due to a modification of the coxal plates. It consists of two joints; the first or basisal supports the second, which, although not fused, is rigidly attached to its extremity. The first is transversely triangular; the lower angle running obliquely from the base to the apex; the second joint consists of a thin plate, compressed longitudinally so as to present four carinæ, the one which in the position of the living animal is directed forwards, and lies against the ventral surface of the pereion, having the extremity considerably produced; it is flattened on one side to correspond with the formation of the coxa of the posterior pair of pereiopoda, while the other side is curved into a deep hollow, which with the corresponding appendage forms a cylindrical tunnel. At the lower anterior extremity of this semitubular plate is a small wart-like excrescence, which, under a magnifying power, is seen to be a mass of small hook-like spines (cincinnuli). The upper division of the same joint is produced into a strong point. The whole arrangement appears to be modified so as to be capable of assisting in the process of copulation, the extended vas deferens being directed to its position by passing through the channel formed by the two converging pleopoda; the plan being similar to but less perfect than that which exists in the Brachyura.

The second pair of pleopoda (*q*) consists of a basal joint supporting two foliaceous plates of a long, flat, ovate form, fringed with long, ciliated hairs; the inner one supports a short, semilunate stylamblys, fringed on the convex margin with short hairs. The third, fourth, and fifth pairs of pleopoda resemble the second, but possess no stylamblys. The sixth pair of pleopoda forms the outer plates of the rhipidura (Pl. XXV. fig. 3); the basal joint is short, broad anteriorly and narrowing posteriorly, where it terminates in

a sharp point or tooth; it supports two broad plates that extend as far as but not beyond the extremity of the telson. The inner plate is scarcely longer than broad, ciliated on the posterior margin, and it carries a tooth-like process at the outer posterior angle; the outer plate, though longer, scarcely extends beyond the posterior extremity of the preceding; it is bisected at one-fourth its distance from the extremity by a serrate diæresis.

The telson is quadrate; the posterior angle on each side is produced into a sharp tooth, while two short prominent teeth stand near the middle of the dorsal surface, and long ciliated hairs fringe the posterior margin.

The specimen here described is a male taken off Manila; two others, both of which are females, were captured off the coast of New Zealand, and are probably of the same species, since they vary in non-essential details, which are probably only sexual. The great distance between the above localities justifies a description of the female, as far as its characters are distinct.

The specimen which I take to be the female of *Nephrops thomsoni* (Pl. XXV. fig. 2) is generally more slender. The rostrum is longer and somewhat broader anterior to the orbits, but the two rows of teeth corresponding with the lateral margins of the carapace are closer together and less conspicuous than in the male. The carapace is less granulose, and the median carina of the posterior division, behind the two sharp teeth, is smooth and free from granular markings. The somites of the pleon are smooth and free from the transverse depressed line that is conspicuous in the male on every somite except the sixth.

The first pair of antennæ is more slender, and the flagella taper gradually to fine extremities.

The second pair of antennæ is more slender than in the male; the scaphocerite is rather longer, and therefore not quite so square in form.

The oral appendages resemble each other. The denticular arrangement, especially on the inner margin of the second pair of gnathopoda, are less conspicuous.

The first pair of pereiopoda is more slender and less granulose than in the male, and the inner margin of the pollex is smooth, except that a solitary cusp or tooth is present near the centre; the double row of ciliated hairs on the inner margin in the male is wanting in the female, and a small sharp tooth is present at the external base of the dactylos. In all other respects the pereiopoda closely resemble those of the male; even the width between them on the ventral surface is not conspicuously greater.

The first pair of pleopoda is uni-branched, slender, and feeble, the four succeeding pairs resemble each other, and are biramose, having long, ovate plates, resembling the same in the male except that neither pair supports a stylamblys.

A second and smaller specimen, taken with the preceding female, differs from it in having a second tooth immediately behind the upper and outer tooth, at the distal extremity of the meros of the first pair of pereiopoda.

There can, I think, be little doubt that the three specimens taken are merely different sexes of one and the same species. It is, however, curious, that during the expedition the only females should be taken off New Zealand, while the only male taken should have been four thousand miles distant.

Family Astacidæ.

The genera of this family are all inhabitants of fresh water rivers, lakes, and ponds.

The podobranchiæ are invariably six, and well developed. The plumes are attached to the mastigobranchial plates in their entire length. Posterior to each of these a sub-lunate process tipped with hairs is articulated. The anterior three pairs of pereiopoda are chelate. The first pair is largest.

The term *Potamobius* was first used by Dr. Leach, in 1819,[1] for the genus *Astacus*, and *Astacus*,[2] for the marine genus to which Milne-Edwards, in his Histoire des Crustacés, afterwards gave the name of *Homarus*, by which it has ever since been recognised.

At that time Milne-Edwards retained the name of *Astacus* for the terrestrial or fresh-water species, by which it has since been universally known; and although, as Dana[3] writes, "Leach has undoubted priority and exhibited his usual discrimination in proposing the subdivision of the old genus," yet to adopt now the name of *Potamobius* instead of *Astacus* would only create great confusion. It is to be regretted that to acknowledge Dr. Leach's claim would not only have this result, which he himself would deprecate, but would introduce terms not likely to be generally accepted.

The Astacidæ of the northern hemisphere have the first pair of pleopoda modified in the male for sexual purposes, and the dactylos of the first or large chelate pair of pereiopoda has the outer margin straight or inflexed. They have never more than one pleurobranchial plume on each side fully developed.

There are two genera in this division, *Astacus*, in which a pleurobranchial plume is attached to the posterior somite of the pereion, and *Cambarus*, which has none. These are confined to the northern hemisphere, and may be found in Europe, Asia, and America.

Those that belong to the southern hemisphere have the first pair of pleopoda wanting, and the dactylos of the first or large chelate pair of pereiopoda has the outer margin convex. There are always one or more pleurobranchial plumes on each side.

[1] *Potamobia fluviatilis*, Leach, Sam. Ent. u. Comp., p. 95, 1819. Mr. Walter Faxon, in his Revision of the Astacidæ, 1885, attributes this generic name to Sowerby in the continuation of Leach's Malacostraca Podophthalmia Britanniæ, No. 8, xviii., xix. Tab. xxxiv. fig. 1, 1875. Adam White in Cat. Brit. Mus., 1850, uses it; and L. Agassiz in the Nomenclatoris Zoologici, Index Universalis, gives *Potamobia*, Leach, Crust., 1818.

[2] *Astacus gammarus*, Leach, Sam. Ent. u. Comp., vol. vii. p. 398.

[3] Dana, U.S. Explor. Exped., p. 532.

This family consists of several genera, dependent rather on their external characteristics than on their branchial arrangement, as may be seen by the following table :—

	Pleurobranchiæ.	Arthrobranchiæ.	Podobranchiæ.	
NORTHERN HEMISPHERE—				
Cambarus, . .	0	11	6	East North America.
Astacus, . . .	1+2*r*	11	6	West North America, Europe and Asia.
SOUTHERN HEMISPHERE—				
Astacoides, . .	1	5+5*r*	6	Madagascar.
Parastacus, . .	4	10+1*r*	6	South America.
Paranephrops, . .	4	10+1*r*	6	New Zealand.
Astacopsis, . .	4	11	6	Australia
Engæus, . . .	4	11	6	Tasmania.
Cherops, . . .	4	11	6	Van Dieman's Land.

These two groups correspond with Astacus and Astacoides of most authors, and with those of Dana, excepting that he eliminates *Paranephrops* from the latter, and places it near to the marine genus *Nephrops*.

With regard to the genera there is no species from the northern hemisphere in this collection, and only three from the southern group, and these belong to the genus *Astacopsis* (Huxley).

Geographical Distribution.—The range of this family is peculiar, the several genera being adapted each to its own locality, no two genera being known to exist in one habitat. Several species of *Astacus* have been found in many of the rivers of Europe and Asia, the islands of Japan, and, according to Faxon, five species exist in rivers in North America, west of the Rocky Mountains, as first noticed by Dana; whereas on the authority of the same writer fifty-two species of *Cambarus* inhabit most of the rivers and lakes of North America east of the same range of hills.

Geologically *Cambarus* has been found as early as the lower Tertiary deposits of the Bear River Valley, Western Wyoming, in North America, and *Astacus* in the Cretaceous beds of Europe, and approximating genera such as *Eryma* in still earlier formations.

Development.—The young quits the ovum in the Megalopa stage, having all its appendages present in a more or less perfect condition. This was shown by Rathke[1] in 1829, to whose account little has since been added.

Dr. Hagen[2] says, "it is easy to discriminate between the sexes of very young individuals of *Cambarus clarkii*. This is the case with those only 0·3 inch long, and while they still occupy the postabdomen of the mother. In the females the sexual aperture is visible at the base of the third set of legs. The first abdominal segment is without any appearance of abdominal legs; in all the other segments the abdominal legs are well developed, their length being nearly two-thirds of the breadth of the post-abdomen, the basal article being oblong, while the length of the double flagellum is a little greater."

[1] Entwickelung des Flusskrebses, 1829.

[2] Monograph of the North American Astacidæ, p. 142.

"In the males the first segment has on each side a little knob, somewhat longer than broad, turning inward. In the interior the developing leg is visible, and its articulation seems marked. This oval knob with rounded tip is the beginning of the first pair of abdominal legs. I have seen the same form of the first abdominal legs in the young of *C. bartonii* even 0·55 inch long." Dr. Hagen also remarks that the ovisac in the true Astacidæ is always burst "into two parts perpendicularly, the segments remaining attached to the stem. This condition makes it probable that the *Astacus* embryo has a particular egg-burster similar to that in the insects," although these interesting parts are little observed or known even by entomologists.[1]

According to Professor Huxley,[2] Rœsel von Rosenhof says that "The young animal, though very similar to the parent, does not 'quite resemble it in all respects,' for not only are the first and the last pairs of abdominal limbs wanting, while the telson is very different from that of the adult; . . . . . ."

Although, at the time when the young quits the ovum, the posterior pair of pleopoda is not advanced to the permanent condition of the adult tail-fan, yet long before it is hatched, and while yet in an embryonic condition, the posterior pair of pleopoda is visible as a two-lobed appendage bearing a close resemblance to those preceding it.

The young, after they quit the egg, continue to grow under the fostering care of their parent, with which they continue attached by means of a small hook at the extremity of each finger of the large claw, which overlap each other when the hand is shut. "Hence when the chelæ have closed upon anything soft enough to allow of the imbedding of those hooks, it is very difficult, if not impossible, to open them again." The same author,[3] again quoting Rœsel, says, "when the mother of these little crayfishes, after they have begun to be active, is quiet for a while, they leave her and creep about a short way off. But if they spy the least sign of danger, or there is any unusual movement in the water, it seems as if the mother recalled them by a signal, for they all at once swiftly return under her tail, and gather into a cluster, and the mother hies to a place of safety with them as quickly as she can. A few days later, however, they gradually forsake her."

Peach [4] says that the fishermen of Goran Haven, Cornwall, "have seen in the summer *frequently* the old lobsters with their young ones around them; some of the young have been noticed six inches long." The circumstance of the young being so large is suggestive of the gregarious habits of the lobster rather than of maternal instinct. In the Amphipod forms, both in *Gammarus*,[5] *Podocerus*,[6] and *Caprella*,[7] as also in *Arcturus*[8] among the Isopods, the young have been observed to cling around and attach themselves to the mother, and when frightened to return to the egg pouch.

[1] *Loc. cit.*, p. 20.
[2] Huxley, Crayfishes, p. 43.
[3] *Loc. cit.*, p. 42.
[4] Bell's History of the British Crustacea, p. 248.
[5] Bate and Westwood, British Sessile-eyed Crustacea, vol. i. p. 380.
[6] *Op. cit.*, vol. i. p. 443.
[7] *Op. cit.*, vol. ii. p. 59.
[8] *Op. cit.*, vol. ii. p. 370.

According to Rœsel and Huxley the young in *Astacus* are attached by means of the first pair of pereiopoda, but according to Mr. Wood-Mason,[1] in the New Zealand species of *Paranephrops* the young are attached by the strong hooked claws of the two hindermost pairs of feet to the swimmerets beneath the pleon.

Astacopsis, Huxley.

Astacopsis, Huxley, Proc. Zool. Soc. Lond., 1878, p. 764.

This genus resembles *Astacoides* of Guérin[2] externally, but differs in having a second joint to the outer branch of the first pair of siagnopoda, in having a larger median ramus, and a longer second joint to the outer branch of the third pair of siagnopoda; in having a basecphysis that reaches to the extremity of the dactylos in the first pair of gnathopoda; in having a two-jointed basecphysis that reaches to the extremity of the ischium in the second pair of gnathopoda, and in having on each side four well-developed pleurobranchiæ, eleven arthrobranchiæ, besides six podobranchiæ, and four movable plates, one of which is attached to the podarthrodial membrane of each of the pereiopoda except the posterior pair.

In *Astacopsis* there are four pleurobranchiæ, eleven arthrobranchiæ, and six podobranchiæ, while in *Astacoides* there are, besides the six podobranchiæ that are common to all the genera of the Astacidæ, ten arthrobranchiæ, five of which are rudimentary, and one pleurobranchiæ. Moreover, the basecphysis of the second pair of gnathopoda is unbranched, and approximating to a rudimentary condition, and that of the first pair is shorter than the limb to which it is attached. The second or terminal joint of the outer branch of the third siagnopoda is short and in a rudimentary condition, and the outer branch of the first siagnopoda has no second joint. The metabranchial plate attached to the fourth pair of pereiopoda is rudimentary instead of being large as in *Astacopsis*.

Geographical Distribution.—Specimens of this genus have been taken in several of the rivers of the southern divisions of the Australian continent, whereas *Astacoides* is confined to Madagascar.

Astacopsis spinifer (Heller) (Pl. XXVIII.).

Astacoides spinifer, Heller, "Novara" Reise, Crustaceen, p. 102, tab. ix., 1865.
Astacus armatus, von Martens, Ann. and Mag. Nat. Hist., ser. 3, vol. xvii. p. 359, 1866.
Australian Crayfish, unnamed, Huxley, The Crayfish, p. 307, fig. 76.
Australian Crayfish, J. E. Gray, Eyre's Journ., Exped. Cent. Aust., vol. i. p. 407.

Rostrum sharp pointed and armed on either side with three sharp teeth near the anterior extremity. Dorsal surface of the carapace smooth and divided by a deep

[1] *Ann. and Mag. Nat. Hist.*, ser. 4, vol. xviii. p. 307.

[2] *Revue Zoologique*, vol. ii. p. 109.

cervical sulcus. Lateral walls tuberculated, with two irregular rows traversing the upper portion of the branchial region and two or three sharp-pointed teeth on the anterior portion of the branchial and hepatic regions.

Pleon dorsally smooth and laterally furnished with numerous large spine-like teeth that increase in number and lessen in size on each somite posteriorly.

First pair of pereiopoda large, chelate, subequal. Margins furnished with small teeth, a double row being on the outer side of the propodos.

Second and third pair chelate, fourth and fifth subchelate and spinous.

Pleopoda absent from the first somite. Those of the four following are biramose. That of the sixth somite is large and foliaceous and forms the outer plates of the rhipidura. The outer plate is furnished with a finely ciliated diæresis.

Telson broad, rounded posteriorly, dorsal surface having many small sharp teeth; posterior margin crenulate.

This species has been fully described and carefully figured by Dr. Camil Heller in the volume on the Crustacea taken during the cruise of the Austrian frigate "Novara," under the name of *Astacoides spinifer*. The year 1865 is appended to the several plates, but the publication of the volume took place in the year 1866. In the month of May in this latter year this same species was also described under the name of *Astacus armatus*, with considerable care and minuteness, by Dr. E. von Martens, who specially remarks on the resemblance of the scaphocerite of the second pair of antennæ, and of the diæresis of the outer plate of the rhipidura to the same parts in *Homarus*.

Both these accomplished zoologists were cognisant of *Astacoides nobilis*, Dana, with which they compared it, and they affirm that it was easily distinguished by the form of the rostrum, that of *Astacoides nobilis* being smooth at the sides and rounded at the extremity, that of *Astacopsis spinifer* being sharp at the extremity and armed with teeth along the sides.

In the Memoir on the Crayfish by Professor Huxley this species has again been figured, one-third of the natural size, under the title of an Australian Crayfish. He adds in a footnote, "The nomenclature of the Australian Crayfish requires thorough revision. I therefore, for the present, assign no name to this Crayfish. It is probably identical with *Astacoides nobilis* of Dana and the *Astacus armatus* of von Martens."

Length, measured from the extremity of the rostrum to that of the telson, 200 mm. (8 in.) male.

Habitat.—Paramatta River, Sydney, New South Wales. Heller gives New Holland as the locality of the specimen he has described, and Dr. von Martens states that his was taken from the Murray River in Australia. Thus it would appear that this species is tolerably well distributed in the provinces, and probably exists in many if not in all the rivers in the southern portion of the great Australian continent, and is probably identical with that mentioned by Dr. J. Gray in a paper on the Australian Crayfishes,

embodied in Eyre's Journal of Expeditions of Discovery in Australia (vol. i. p. 409, 1845), as "a large species living in the said river (Murray), weighing about two pounds, and possessing the same flavour as the European lobster." Dana records his *Astacopsis* (*Astacoides*) *nobilis* from New South Wales, with a query attached.

The carapace is one-half the length of the animal, anteriorly produced to a short rostrum that tapers to a sharp-pointed depressed tooth, on each side of which posteriorly are three distinct teeth that gradually lessen in size and then fade away leaving only rudimentary traces of denticulation. The ridge on which these teeth stand increases in size as the teeth diminish to a short distance behind the orbital margin. Between these ridges the median surface of the rostrum is depressed and forms a longitudinal groove that fades away on the gastric region. On each side of the base of the rostrum, posterior to the orbit, is a longitudinal tooth, but slightly projecting to a point, and grooved in its entire length, behind which another small cusp-like tooth projects anteriorly from a low tubercle. Lateral to the preceding, on the hepatic region, are four sharp strong teeth on one side, while on the other some of them are reduced to small tubercles. The dorsal surface of the carapace is smooth and almost polished on the gastric region, which is separated from the cardiac by a deep cervical sulcus. The dorsal surface of the cardiac region is smooth and separated from the branchial regions by a longitudinal furrow that traverses the dorsal surface from the cervical sulcus to a short distance from the posterior margin of the carapace. The whole of the branchial region is evenly covered with small tubercles, the upper portion being armed with two rows of large and prominent tubercles, the dorsal row having the appearance of being much worn down; near the anterior extremity of the branchial region, just behind the lateral portion of the cervical groove, are four or five rather long and sharp-pointed teeth.

The pleon has the anterior portion of each somite depressed and the posterior elevated; the dorsal surface is smooth in the median line, and is flanked on each side with a row of large tubercles, one to each somite, that on the fifth being the smallest and most pointed; on each side, standing on the coxal plates, is a series of long and strong spine-like teeth that are directed vertically from their base.

The first somite carries no appendage, consequently the coxal plate is wanting, and a single tooth stands near the margin.

The second somite has one large tooth standing near the middle of the lateral margin of the somite, and five others, smaller but still large teeth, in a line lying a little within the margin of the coxal plate.

The three following somites are armed with a large tooth near the centre of the lateral margin, and two below it, one above the other, in the median line.

The sixth somite has a bunch of five smaller teeth on each side of the narrow, smooth, median dorsal surface.

The ophthalmopoda are short, reaching but little beyond the frontal margin of the carapace, and are deeply situated in an almost circular orbit and protected by a deep fringe of hairs that spring from the lower margin of the rostrum, and from the distal outer and inner margins of the first joint of the first pair of antennæ.

The first pair of antennæ is situated beneath the rostrum and ophthalmopoda. The first joint of the peduncle is triangulate. The upper surface is flattened and formed into a hollow by the inner margin being raised into a perpendicular ridge for half its length, which represents the prosartema that forms such a peculiar structure in *Penæus*. The inner side is flat and corresponds with that of the opposite antenna, and is furnished with a small tooth on the lower margin. The under side is oblique, passing from the lower margin of the inner side to that of the outer margin of the upper. The first joint is longer than the ophthalmopoda, and longer than the two succeeding joints, which altogether do not reach to the extremity of the rostrum. The second and third joints project a little on the inner distal margin to a small cusp that is tipped with hairs. The flagella are subequally stout and about three times the length of the peduncle. In the centre of the upper surface of the first joint, where the ophthalmopod lies when at rest, is a small orifice, fringed with short hairs, leading to the internal auditory apparatus.

The second pair of antennæ occupies a large portion of the metope, or facial wall. The first joint is articulated, with a very slight power of movement, with the metope, and supports a prominent phymacerite that is strongly calcified, with the exception of a small membranous orifice; immediately above the phymacerite, standing on the margin, is a sharp and slender tooth, and the rudiment of another on the outer side. The second joint possessing only a slight lateral movement, articulates with the first by rotating on the small external tooth, and extends inwards as far as the inner or longer tooth; it is armed on the outer distal angle by a stout and powerful, obliquely directed, conical tooth, on the inner side of which stands a short and sharp-pointed scaphocerite, which is broad at the base and articulates by a process with its upper and lower margins. The outer margin projects at the base and is continued to the apex as a strong, rigid, and sharp tooth; it possesses only a lateral movement and that of little extent; the projection at the base on the outer side falls against the large tooth projecting from the outer distal angle of the second joint, and there rests and receives support that makes the tooth at the distal extremity of the scaphocerite an important and powerful weapon of offence: the third joint corresponds with the inner side of the second, and articulates with it in a longitudinal direction, the distal extremity, projecting anteriorly, articulates with the fourth joint obliquely on the outer side, thus giving it an upward, downward and slightly rotatory movement; the fifth joint articulates with the preceding at the distal extremity and has only a lateral movement, and therefore has its points of articulation on the upper and lower margins; the distal extremity supports a flagellum

that is abruptly smaller than the terminal joint of the peduncle, is slightly compressed, and is subequal in length to the carapace.

The ventral portion of the second antennal somite forms the metope and passes laterally beneath the frontal margin of the carapace, with which it is closely connected by membranous if not calcified attachments. The anterior portion is produced forwards as a projecting rostrum and sends a keel-shaped process up between the peduncles of the second pair of antennæ as far as the distal extremity of the third joints. It is generally furred with short hairs and armed on each side with four or five small tooth-like processes.

The lower margin is developed into a transverse bar-like epistoma, at the extremities of which is a cup-like hollow that receives the anterior articulating process of the mandibles.

The mandibles (*d*) are broad concavo-convex appendages, the convex surface from the extremity of the incisive margin to the distal articulating extremity of the apophysis is external, while the concave surface from the same articulation to the transverse molar ridge is internal. The mandible thus forms the inner wall of the channel of exit from the branchial chamber, and forms a partition between it and the internal viscera. The psalistoma has the margin rounded and armed with three cusps, of which the centre is the largest, and indications of others exist along the posterior margin, while the molar ridge is produced anteriorly as a long process, the extremity of which articulates in the cup at the lateral extremity of the epistoma; between this articulation and the base of the psalistoma articulates a three-jointed synaphipod which is short, hairy, and curved so as to correspond with and fall into the concave surface between the psalistoma and the molar ridge, which it occupies jointly with the lateral processes of the styloglossa. The articulation at the extremity of the apophysis is cup-shaped, and rolls upon a rounded tubercle that projects from the inner surface or ridge that corresponds with the cervical fossa upon the external surface of the carapace.

The first pair of siagnopoda (*e*) is three-branched, the inner ramus is short, rigid, and curved; the central is broad, flat and truncate, and the outer is cylindrical, slender, and biarticulate.

The second pair of siagnopoda (*f*) is three-branched and four-jointed; the first or coxal joint is short and supports a large mastigobranchial plate that posteriorly reaches into the branchial chamber and anteriorly sweeps the channel of exit; the second or basisal joint is of considerable tenuity and divided into two foliaceous branches; the third joint is similar to the second, but broader and more leaf-like; the fourth joint is long, slender, and tapering, and reaches beyond the anterior extremity of the mastigobranchia, but not as far as the distal extremity of the preceding branch.

The third pair of siagnopoda (*f*) is drawn of the natural size and therefore appears comparatively much smaller than the second, which is drawn two and a half times larger than its natural size. It consists of four joints that are obscurely

connected; the first carries a large mastigobranchia that projects far into the branchial chamber, but is folded and not produced anteriorly; the second and third joints are closely associated and form a long concavo-convex plate of considerable tenuity, fringed with hairs, the second being furnished on the outer side with a long biarticulate ecphysis; the basal joint is longitudinally triangulate, the margin of each angle being fringed with hairs, the second joint is multiarticulate and distally spatuliform; the fourth joint is short, narrow, curved and tapering.

The first pair of gnathopoda (*h*) is subpediform, six-jointed, the dactylos probably being absent. The coxa carries a long mastigobranchia, to the outer margin of which the podobranchial plume is connected in its entire length; the second joint carries a biarticulate ecphysis, the basal joint of which is long and subcylindrical, and the terminal is multiarticulate and terminally spatuliform; the ischium is long and broad, rather more so than figured; the meros is short and reflexed, the carpos is broad and distally produced on the outer distal angle, and the propodos is small and ovate, the whole of the limb being thickly fringed with hair.

The second pair of gnathopoda (*i*) is pediform and seven-jointed. The first or coxal joint is broad, thin, concave below and projecting backwards, supports a long mastigobranchial plate fixed similarly to the preceding, and is furnished with a branchial plume on the outer surface; on a small tubercle on the upper surface of the coxa is a fasciculus of very long hairs. The basis or second joint carries a biarticulate ecphysis that resembles that of the first pair of gnathopoda, only it is relatively shorter since it does not reach beyond the distal extremity of the ischium or next succeeding joint: the ischium is long and longitudinally arcuate, the convex surface being below, the upper or concave surface smooth, narrower at the basisal extremity than at the meral; the inner margin is serrate with many small blunt cusps. The under surface is fringed within the inner or serrate margin by a row of closely planted fasciculi of hairs, in the median line of the same side is an obtuse carina, furnished with several distantly placed fasciculi of hairs: the meros articulates obliquely at the distal extremity of the ischium, than which it is much narrower; distally it thickens in width and depth, becoming triangulate at the extremity, where it articulates with the carpos or fifth joint on the inner distal angle, which also increases in diameter distally and articulates with the propodos, which is long, narrow, and ovate, and fringed with hairs on the inner, upper, and lower margins: the dactylos is pointed, tapering, and fringed with hairs, but not unguiculate.

The first pair of pereiopoda (*k*) is about two-thirds the length of the animal; it is chelate, the fingers being subequal in length to the palm; the propodos is ovate and fringed on the polliciform margin with a double row of longitudinal cusps, and on the dactyloid margin with a single row of six teeth, the posterior of which projects at a right angle and rests against the carpos, and the anterior projects over the dactyloid membranous articulation; on the under and upper surface corresponding with the articu-

lar processes of the dactylos is a large cusp or blunt tooth, the inner side of which is hollowed to receive the tubercular articulation of the dactylos. The dactylos reversely corresponds with the pollex, but it is smooth on the outer margin excepting two or three teeth near the distal extremity; the inner surface is bordered by a row of cusps more numerous but less prominent than those on the pollex: the carpos is distally furnished with two strong cusps that correspond with the articulating processes of the propodos on the upper and lower distal margins, on the inner surface there is one sharp tooth near the middle of the anterior margin, two, one very large, on the upper margin, and two small cusps on the under: the meros is broader distally than at the ischial extremity, it is smooth and slightly arcuate longitudinally on the upper surface and convex on the lower, it is armed on the outer margin with a row of teeth that gradually increase in size anteriorly, and with two rows on the inner: the ischium is short, flat, unarmed, and articulates with the meros on the inner and outer distal angles by means of strong cusp-like processes, and at the outer coxal angle is a posteriorly projecting process that affords resistance to the too free backward movement of the joint: the coxa is triangulate and articulates at two points, one externally corresponding with the posterior angle of its own somite, and the other internally with a projecting process on each side of the median ventral carina; attached to the coxa on the outer surface is a large mastigobranchial plate, which is divided into two longitudinal processes, to the upper or median angle of which a podobranchial plume is attached throughout its entire length. The anterior process of the plate dips down longitudinally between the anterior and posterior arthrobranchiate plumes, its lower margin reaching to the pleurobranchial plume; the posterior passes over the posterior arthrobranchial plume and separates it from the podobranchial (*vide* sectional diagram of branchiæ in Pl. XXVIII.), the long hairs that cover the inner surface pass between the several filaments of the plumes and probably prevent them from pressing unduly against each other. This arrangement appears to be constant with all the appendages, excepting that the mastigobranchial plate is less pronounced posteriorly than anteriorly; the posterior pair carries a pleurobranchial plume only, attached to the posterior somite of the pereion.

Attached to the membranous articulation, between the coxa and the somite below the arthrobranchial plumes, is a lunate appendage (*mt*), the homology of which is difficult to interpret; there are four pairs, one attached to each pair of pereiopoda excepting the posterior. I have not been able to find it in our British species of *Astacus*, but it exists in the three species of *Astacopsis* in this collection, and also in *Astacoides madagascarensis*. I have not yet had the opportunity of examining other genera.

I know of nothing that these parts can be homologous with, unless they be the rudiments of the foliaceous appendages forming the incubatory pouch of those females that carry their ova beneath the pereion. It might seem an objection that in *Astacopsis* they exist in the males as well as in the females, but if they be rudimentary and

obsolete organs, there is no anatomical reason why they may not be present in the males as well as the rudimentary mammæ in the males of the Mammalia.

The second pair of pereiopoda is shorter and much more slender than the first, it is chelate, the propodos not being larger than the carpos; the fingers are slender and correspondingly curved and adorned with a series of distantly planted fasciculi of hairs, and the meros is armed with a few teeth on the outer margin, and two or three on the inner near the carpal articulation.

The third pair of pereiopoda resembles the second but is more slender and less strongly armed.

The posterior two pairs of pereiopoda are a little shorter than the preceding, they are more conspicuously armed on the outer side of the meros and carpos and on the upper side of the propodos, which is more slender, than in the preceding two pairs, and the inner distal angle is produced to a short pollex that is about one-third the length of the dactylos and therefore is only sub- or imperfectly chelate. The last four pairs of pereiopoda, like the first, articulate with a process on each side of the median ventral carina, and these processes increase in size and importance, and separate slightly, as they proceed posteriorly.

The first pair of pleopoda is wanting; the second and succeeding resemble each other; they consist of a basisal joint and two compressed branches, having parallel margins thickly fringed with hairs.

The posterior pair, which helps to form the rhipidura, is broad and corresponds in length with the telson. The inner branch is armed with three or four teeth longitudinally placed in the median line and corresponding with a slight elevation; the outer plate is ribbed in the median line and armed with a few teeth near the outer margin. A diæresis divides the plate one-third from the distal margin, and is fringed with a regular series of small sharp-pointed teeth, of which the largest exists on the outer margin, and one corresponds with the extremity of the median rib, whence they gradually diminish and disappear on the inner side. The distal portion of all the plates of the rhipidura is submembranous, finely corrugated, and fringed with hairs.

Astacopsis paramattensis, n. sp. (Pl. XXVII. fig. 1).

Carapace dorsally broad and smooth. Anterior division laterally dentate, posterior division laterally tuberculate.

Pleon dorsally smooth, laterally tuberculate. Telson denticulate, and posteriorly minutely corrugated.

First pair of pereiopoda subequal; surface smooth, margin denticulate; carpos with two teeth on the inner margin; meros longitudinally denticulate on the upper and lower margin.

Length (female), 94 mm. (3·75 in.).

Habitat.—One specimen taken in the Paramatta River, Sydney, Australia.

The carapace is dorsally smooth, having very minute punctations, which are more numerous and smaller on the anterior division than on the posterior.

The rostrum is long, broad, and pointed, dentated with four or five small teeth on each side, the margins, which are pilose and more elevated than the intervening surface, continue posteriorly beyond the orbits, outside the line of which on each side are two teeth, placed slightly diagonally one behind the other; others not so large or important are situated on the outer side of the antennal angle. Posterior to the cervical suture the branchial regions are furnished near the upper surface with several large, flattened, dark brown tubercles, while between and below them the surface is studded with a considerable number of small light-coloured tubercles, and on each side behind the cervical suture are three short stout teeth.

The pleon is very smooth. The fourth and fifth somites have each two small fasciculi of short hairs on the posterior margin, while the sixth has four: the telson has two subcentral fasciculi of short hairs, and on each side an oblique row of small teeth, and posteriorly a row of three small teeth, while a strong one on each side forms the division between the straight lateral and the posterior semicircular margins; the surface of the posterior division is delicately and evenly corrugated.

The lateral margin of the first somite is armed with one strong cusp, which corresponds with the large internal cusp or tubercle on the second somite, outside which are three marginal teeth. The third, fourth, and fifth somites have each one internal and one marginal cusp, and the sixth only a rudimentary marginal one.

The first pair of antennæ has the peduncle shorter than or subequal to the rostrum.

The second pair of antennæ has the peduncle extending slightly beyond the rostrum, and the scaphocerite extends as far as the extremity of the peduncle and terminates in a sharp point; the outer margin on the lower side, and the inner or oblique margin, are fringed with thickly-set plumose hairs. The flagellum reaches as far back as the posterior margin of the fifth somite of the pleon. The second joint of the peduncle is armed with a strong tooth on the outer side (which is erroneously represented in the figure as being on the margin of the carapace).

The oral appendages and the two pairs of gnathopoda offer no distinguishing feature from those of other species.

The first pair of pereiopoda is large and subequal. The surface of the hands is smooth, slightly hirsute on the upper and lower surface of the pollex and dactylos, which, when closed, impinge together throughout their entire length, the dactylos falling into a small longitudinal groove in the pollex; the outer margin is fringed with a double row of depressed points, the inner with a solitary row on a distinct ridge: the carpos is armed on the upper surface with two small sharp teeth, beneath, on the anterior margin, with a strong tooth inside and one outside of the articulating process, and on the inner surface with one large and one small tooth: the meros has a row of three or

four teeth on the upper margin, of which the second is the most conspicuous; the lower divides into two, each being armed with a few conspicuous teeth.

The second and third pairs are slender and chelate and armed on the upper or outer margin of the meros with three or four sharp teeth.

The fourth and fifth pairs are subchelate and have two sharp teeth on the anterior part of the upper margin of the meros, and two or three on the lower. They have the propodos roughened on the outer side by numerous anteriorly-directed tubercles, the summits of which are crowned with a fasciculus of stiff hairs; that on the inferior distal extremity of the posterior pair is also armed with a small tooth and forms a rudimentary pollex; the dactylos in each is much longer than the pollex and narrower than the propodos.

The posterior pair of pleopoda, forming the lateral plates of the rhipidura has a distinct smooth ridge down the middle of the inner and outer plates. On the outer it is produced to the posterior margin, passing through the minutely serrate diæresis; on the inner it terminates in a sharp tooth within the margin.

Observations.—The specimen from which I have drawn the description is a female, apparently of mature growth, being nearly 4 inches in length. It has the vulva closed by a calcified operculum. In general aspect it more nearly resembles the specimens of *Astacopsis franklinii* of Gray than any others; but differs from them in several details, among which the most conspicuous are the absence of a strong cusp or tooth from the centre of the pollex of the first pair of pereiopoda, the presence of conspicuous teeth on the first antennal region of the carapace, the large tubercles on the branchial region, and the absence of five or six sharp teeth on the lateral walls or coxal plates of the second somite of the pleon.

Astacopsis sydneyensis, n. sp. (Pl. XXVII. fig. 2).

Carapace smooth with microscopically small punctations and hairs. Rostrum having three small teeth on each side. Two teeth, one before the other, on each side behind the orbit. Pleon smooth. Telson slightly dentate and corrugated.

First pair of pereiopoda slightly unequal, surface smooth, margins slightly roughened. Carpos with one tooth on the inner and one on the upper margin; meros with three on the upper and three on the lower margin.

Length (female), 50 mm. (2 in.).

Habitat.—Sydney, Australia. One specimen.

The carapace is smooth and minutely punctate over the entire dorsal surface, laterally sparsely covered with microscopically small hairs, which on the branchial region exist in small fasciculi. The rostrum tapers to a sharp point, and the sides are

fringed with short hairs, amongst which are three small sharp teeth on each side, of which the anterior is the most important. Behind the orbits are two sharp teeth one before the other, and more laterally is a third much smaller one. Two small teeth are also situated on the posterior margin of the lateral extension of the cervical depression.

The somites of the pleon are dorsally smooth, and have the lateral margins rounded, with but a slight tendency to come to a point infero-posteriorly.

The telson has the lateral margins parallel, and the terminal semicircular margin is defined by a strong tooth on each side and fringed with a copious brush of plumose hairs. The dorsal surface supports on each side of the median line a small fasciculus of hairs and two small sharp teeth, posterior to which the plate is submembranous and rugose.

The first pair of antennæ has the peduncle shorter than the rostrum, not reaching beyond the anterior teeth. The outer branch is longer but not stouter than the inner, which may be due to our specimen being a female.

The second pair of antennæ carries a strong sharp tooth, on the outer side of the joint that supports the squamous appendage, the value of which may be appreciated from the description of the same under *Astacopsis spinifer* (erroneously figured on Pl. XXVII. as being part of the anterior margin of the carapace); the latter reaches rather beyond the apex of the rostrum, while the extremity of the peduncle scarcely reaches the same point. The flagellum is about two-thirds the length of the animal.

The appendages of the mouth vary but little from those of other species of the genus.

The first pair of gnathopoda is a little slighter than those in *Astacopsis paramattensis*. But there is very little variation in the second pair, while it differs from that of *Astacopsis spinifer* in having the basecphysis or outer branch longer than the ischium.

The first pair of pereiopoda has the right hand larger than the left, but otherwise they resemble each other; the surface is smooth, the inner and outer margins of the propodos are crested and slightly denticulate; the carpos is armed with a single sharp tooth on the inner margin and one on the inferior margin of the propodal articulation; the meros is armed with three sharp teeth on the superior margin and three on the inferior on the right side, on the left there are three teeth on the superior and only one on the inferior, the two posterior being rudimentary.

The second and third pairs are slender and chelate, the fourth and fifth simple, and have the distal extremity of the propodos fringed with a brush of hairs, but no polliciform process.

The first pair of pleopoda is absent; the four succeeding pairs are similar to each other, having the two rami subequally long, narrow, and fringed with plumose hairs.

The sixth pair which, with the telson, goes to form the caudal fan or rhipidura, has each branch or plate, the inner as well as the outer, armed on the outer side by a strong and sharp tooth, and the posterior margins fringed with plumose hairs.

Observations.—This specimen appears very closely to resemble *Astacus australasiensis*, Milne-Edwards, recorded from New Holland,[1] from which it appears to differ in several details, the most distinguishable being that it has three small teeth on each side of the rostrum instead of one, that it has two teeth longitudinally situated on the carapace on each side behind the orbit instead of being smooth, and one tooth instead of three on the inner margin of the carpos of the first pair of pereiopoda, and that the inner margin of the propodos is less strongly serrate.

The inner margin of the second pair of gnathopoda is serrate, while the drawing of the part shown in Milne-Edwards' figure represents it as perfectly smooth.

Milne-Edwards' description is stated to be taken from a young animal. Ours is from a female, but whether fully grown or not there is no means of determining. The vulva appears to be imperforate, but whether this be due to the immature condition of the ovaries, or, as I am inclined to believe, from a recurring state of biannual rest, we are not at present able to determine. I have observed the calcified condition of the vulva in numerous instances where there was clear evidence of adolescence, a circumstance that induces me to believe in the probable correctness of the opinion that these animals may breed only every other year.

Tribe Stenopidea.

Anterior margin of the carapace produced to a laterally compressed rostrum. Anterior three pair of pereiopoda chelate, of which the posterior pair is the longest and largest.

Branchiæ filamentous.

Brephalos, a Megalopa or a Zoea.

In this tribe there is but a single family.

Family Stenopidæ.

Podobranchial plume absent from all excepting the first pair of gnathopoda. Posterior pleurobranchial plume the largest. Basecphysis of the second pair of gnathopoda small, slender, and almost rudimentary.

The two genera that are here grouped together in this family have by all preceding carcinologists, including Milne-Edwards, de Haan, and Dana, been placed in the family of the Penæidæ.

This was done, it appears to me, on the external evidence that *Penæus* has, in common with *Stenopus* and *Spongicola*, the anterior three pairs of pereiopoda developed in the

[1] Hist. Nat. Crust., vol. ii. p. 332, pl. xxiv. figs. 1–5.

form of chelæ, of which the third pair is the longest as it is also the largest. There is no other external anatomical detail or feature of importance that supports this view, whereas there are some very decided ones that bring them both into the same group with the normal division of the Trichobranchiate Macrura, as for instance the trichobranchiate character of the gills.

Professor Huxley, in his Memoir on the Classification of the Crayfishes,[1] was the first to point out that "by the structure of its branchiæ *Stenopus* is sharply separated from *Penæus*, with which it has hitherto been associated, although it approaches *Penæus* in the almost complete abortion of the branchial element of the podobranchiæ."

This may be the case in comparison with some species, but the branchial arrangement in several genera of the Penæidæ varies from what has hitherto been considered characteristic of the family.

The anterior three pairs of pereiopoda characteristic of *Penæus* is common to all the Astacidæ, the only variation being that in *Astacus* the first pair is the largest, whereas in *Penæus*, *Stenopus* and *Spongicola* it is the smallest; in the Astacidea all the legs, especially in the females, have a tendency to form chelæ, whereas in the Penæidea this character never appears posterior to the third pair, and in the Phyllobranchiata never beyond the second. In all the Astacidea the brephalos is in the Megalopa stage, as probably is the case in *Stenopus*,[2] while that of *Spongicola* is in the Zoea form.

If we take the typical forms of the Astacidæ, and compare their several parts analytically with those of the genera in the family Stenopidæ, we shall find that the variations are of little more than generic importance:—

The animals generally are subcylindrical. In *Astacus* the rostrum is flattened horizontally, in *Spongicola* and *Stenopus* it is vertically compressed as it is in *Phoberus*.

The ophthalmopoda are short in both.

The first pair of antennæ supports two flagella in both.

The second pair supports a scaphocerite which is short in *Astacus*, not long in *Spongicola*, but long in *Stenopus*.

The mandible has a two-jointed synaphipod in *Astacus*, and a three-jointed one in *Stenopus* and *Spongicola*. The first pair of siagnopoda in *Stenopus* has the outer branch single-jointed and reduced, a condition seen in *Astacus fluviatilis* and *Astacoides madagascarensis*.

The second pair of siagnopoda is almost identical with the same appendage in *Astacus fluviatilis* in having the inner lower plates broader than the upper, the reverse of what exists in *Astacopsis*.

[1] *Proc. Zool. Soc. Lond.*, 1878, p. 780.

[2] Observations of an incomplete character induce me to believe that the brephalos of *Stenopus* is in the Megalopa stage.

The third pair of siagnopoda differs in having the mastigobranchial plate transversely divided by a rib, thus making an anterior and a posterior division in *Spongicola* and *Stenopus*, whereas the posterior division alone exists in *Astacus;* and the central branch is uni-articulate, while in *Spongicola* it is two-jointed, and in *Stenopus* four-jointed.

In both families the first pair of gnathopoda is six-jointed, and they resemble each other in form. In *Astacus* the podobranchial plume is developed as part of the mastigobranchial plate, a feature that is peculiar and, so far as we know, confined to the family Astacidæ, whereas in the Stenopidæ, the two genera which comprise the family have the podobranchial plumes absent from all the appendages of the pereion except the first pair of gnathopoda, where they are reduced to an almost rudimentary condition and attached at the base only to the mastigobranchial plate.

The second pair of gnathopoda is pediform in each family, but short and robust in *Astacus*, and comparatively long and slender in *Stenopus;* it carries in both families a basecphysis, which in *Spongicola* is small and rudimentary, as in *Astacoides madagascarensis*, while in *Stenopus* it is extremely short and feeble. The mastigobranchia is reduced to a rudimentary condition and the podobranchia is wanting in the Stenopidæ, while in the Astacidæ the podobranchia is developed on and forms part of the mastigobranchial ramus.

The pereiopoda in the Stenopidæ are long, and, with the exception of the third pair, slender, and possess the characteristic Penæid feature of having the carpos longer than the propodos, with the exception of the third pair, which is shorter in *Stenopus* and still more so in *Spongicola*. The carpos in all the Astacidæ is shorter than the propodos, and the legs have consequently a comparatively shorter and more robust appearance.

The first pair of pleopoda in the Astacidæ is modified in form for sexual purposes in the males of the northern hemisphere and wanting in both sexes in the genera of the southern hemisphere. In the Stenopidæ it is uni-branched and foliaceous.

The second and succeeding pairs in the Astacidæ and Stenopidæ are biramose, foliaceous, and possess not even the rudiment of a stylamblys; the posterior pair in the Stenopidæ has the outer plates of the rhipidura without a diæresis, and the telson has no transverse division, while in all genera of the Astacidæ there is a division or diæresis more or less perfectly defined.

By thus reviewing and comparing the two families we find that the Stenopidæ correspond with the Astacidæ in the structure of the branchiæ, in having eleven pairs of arthrobranchiæ, in having five pairs of pleurobranchiæ in comparison with four in the Australian genera; also in the form of the mandibles and first two pairs of siagnopoda, as compared with the genus *Astacus*, and in the subpediform condition of the two pairs of gnathopoda. On the other hand, distinctions exist in the character of the rostrum, which is compressed horizontally in the Astacidæ, and vertically in the Stenopidæ; in the scaphocerite being long or moderate in the Stenopidæ, and short in Astacidæ; in

the third pair of siagnopoda being uni-jointed in the Astacidæ, and two or more jointed in the Stenopidæ; in the first pair of pereiopoda being the largest in the Astacidæ, and the smallest in the Stenopidæ; in the carpos being longer than the propodos in the Stenopidæ, and shorter in the Astacidæ; in the rhipidura being without a diæresis in the Stenopidæ, thus corresponding with the Synaxidea, whereas in the Astacidæ there is always a diæresis in the outer plates, and more or less indication of one in the telson. In the Stenopidæ the podobranchial plume is wanting in all the pereiopoda and in the second pair of gnathopoda, the first pair alone having a branchial plume attached to the mastigobranchia, and this is diminished in size. In the Astacidæ the podobranchiæ are present, united with the mastigobranchial plate, from the first pair of gnathopoda to the penultimate pereiopoda.

In the Astacidæ the ova are large and numerous, and the brephalos produced in the Megalopa stage. In the Stenopidæ the ova are very numerous and small, and the brephalos produced in the Megalopa stage in *Stenopus* and in the Zoea stage in *Spongicola*.

Stenopus, Latreille.

Stenopus, Latreille, Règne anim. de Cuvier, ed. 2, vol. iv. p. 93.
„ Desmarest, Consid. sur les Crust., p. 226.
„ Milne-Edwards, Hist. Nat. Crust., vol. ii. p. 406.
„ Dana, U.S. Explor. Exped., p. 601, 1852.

Carapace furnished with a rostrum laterally compressed.

First pair of antennæ having two flagella. Second pair having a long, flat, and obtusely pointed scaphocerite, the apex being continuous with the external margin. Flagellum long and slender. Siagnos (or mandible) furnished with a three-jointed synaphipod, of which the terminal joint is the longest. Third pair of siagnopoda terminating in a small sharp dactylos.

The first pair of gnathopoda short, six-jointed, furnished with a long basecphysis, and the coxa supporting a small mastigobranchial plate, carrying a small, but well-formed podobranchial plume.

The second pair of gnathopoda long, slender, seven-jointed, supporting a small, slender, uniarticulate basecphysis, the coxa supporting a rudimentary mastigobranchial plate without any podobranchial plume.

The anterior three pairs of pereiopoda chelate, the posterior being the longest and largest. The first two pairs have the carpos longer than the propodos; in the third pair it is not quite so long.

The posterior two pairs are slender, having the carpos very much longer than the propodos, both of which are multiarticulate and terminate in a double-pointed dactylos. All the pereiopoda support rudimentary mastigobranchiæ without any podobranchial plume.

The first pair of pleopoda in the female is biarticulate, uni-branched and foliaceous; the second biramose and foliaceous, carrying no stylamblys; outer plates of the rhipidura without a diæresis. Telson long and tapering.

This genus is very closely related to *Spongicola* in most of its anatomical details.

The eyes and the first and second pairs of antennæ are of the same generic value. The scaphocerite in *Spongicola* is of moderate length, relatively broad at the base, and somewhat tapering towards the extremity, but not ending in an acute point, while in *Stenopus* it is long, with the margins subparallel. The mandible and first two pairs of siagnopoda are similar in the two genera, but the third has one more joint to the limb proper in *Stenopus* than in *Spongicola*. The two pairs of gnathopoda are also generically of the same value respectively as those of *Spongicola*. The form of the first pair is almost identical in the two genera. The second pair differs in relative length, and the basecphysis in *Stenopus* is short, slender, uniarticulate, and feeble, while in *Spongicola* it is short, two-jointed, and robust; so rudimentary that it escaped the observation of de Haan and other carcinologists, who state that it is wanting.

The pereiopoda are mostly of the same generic value, and support a similar branchial arrangement. In both genera the third pair of pereiopoda is the largest, in *Stenopus* it is long and slender, in *Spongicola* it is long, but the propodos is very broad, and the carpos short; the posterior two pairs are not multiarticulate, and terminate in a triunguiculate dactylos, whereas in *Stenopus* they are multiarticulate and terminate in a biunguiculate dactylos.

The pleopoda are also of the same generic value, and the telson is long and tapering almost to a point, whereas in *Spongicola* it terminates in a rounded or obtuse extremity.

In general character *Stenopus* is long, slender, and spinous. In *Spongicola* the animal is shorter, more robust and smooth. But, with the exception of the spinous condition of *Stenopus*, the feature that chiefly influences the general appearance is the shortness of the carpos, and the great thickness of the propodos in the third pair of pereiopoda of *Spongicola* when compared with the same in *Stenopus*.

Geographical Distribution.—It has been chiefly recorded from the eastern seas and the shores of India by Desmarest, Milne-Edwards, and Sir Walter Eliott; from Japan by de Haan; from the "Coral Reef of Raraka, one of the Paumotu Islands; also Balabac Passage north of Borneo," by Dana, who has determined a second but somewhat less spinous species (*Stenopus ensiferus*) from the Fiji Islands; while the Challenger brought home one specimen from the Fiji Islands, as well as one from Bermuda; and, according to Risso, a species, *Stenopus spinosus*, has been taken in the Mediterranean Sea. Milne-Edwards[1] says, "*Squilla groenlandica* of Seba, which Herbst calls *Cancer astacus longipes*, and placed by Olivier in the genus *Palæmon*, appears to be a mutilated specimen of this species (*Stenopus hispidus*), of which the two large feet

[1] Hist. Nat. des Crust., vol. ii. p. 407.

have been broken off, an accident which might very easily happen. Latreille has represented, under the name of *Palemon* (?) *asper*, one of the figures of *Squilla groenlandica*, Seba, reproduced in the Atlas of the Encyclopedia Methodique (pl. ccxciii. fig. 3, explication, p. 3), and finally, the same figure has again been reproduced by Latreille, in his Histoire naturelle des Crustacés et des Insectes, under the name of *Crangon boreal*, in pl. liii. fig. 3, and under the name of *Penée boréal* in the text (vol. vi. p. 250)."

The genus thus appears to inhabit regions so widely apart as Greenland in the north, the Bermudas and Mediterranean in the west, and the southern coasts of India and the Fiji Islands in the east. It has been found in the cold water of the Arctic regions as well as in the warm shallow waters of the Tropics, but despite this cosmopolitan range it has not been recorded as having existed in any geological formation.

The species *Stenopus spinosus*, Risso, from the Mediterranean, according to Milne-Edwards, differs from *Stenopus hispidus* only in the absence of a median row of spines upon the external surface of the propodos of the large chelate pereiopod.

Stenopus hispidus (Pl. XXX.).

Stenopus hispidus, Olivier, Encyclop., vol. viii. p. 666.
„ „ Latreille, Règne anim. de Cuvier, ed. 2, vol. iv. p. 93.
„ „ Desmarest, Consid. sur les Crust., p. 227.
„ „ Milne-Edwards, Règne anim. de Cuvier, Crust., ed. 3, pl. l. fig. 2; Hist. Nat. Crust., vol. ii. p. 407, pl. xxv. fig. 1.
„ „ Dana, U.S. Explor. Exped., p. 607, pl. xl. fig. 8.

Entire animal covered with small, sharp, strong spines, vertical on the carapace and dorsal surface of the first three somites of the pleon, almost horizontal and directed posteriorly on the three posterior somites and telson. The peduncle of the second pair of antennæ is furnished with spines, so are the third pair of pereiopoda, and the basisal joints of the pleopoda; all the other appendages are smooth.

The posterior two pairs of pereiopoda are multiarticulate from the commencement of the carpos to the extremity of the propodos. The third or largest pair of pereiopoda is very long and freely covered with teeth, which run in several longitudinal rows, those of the upper and lower margins being laterally compressed and closely implanted, longitudinally touching each other at their base, the apex of each tooth being directed toward the dactylos. The pollex is furnished with two cusps with a cleft between them, into which fits a broad sharp cusp attached to the dactylos.

Habitat.—Kandavu, Fiji Islands, Bermuda, shallow water.

This species has long been known, but though attracting attention from its peculiar formation, was described only according to its external characters until Professor Huxley examined the nature of its branchial apparatus.

The podobranchial plume is absent from all the appendages except the first pair of gnathopoda (*h*), where it is short but well formed, and attached to the base of a small but efficient mastigobranchia that equals the podobranchial plume in length, and lies between and separates the plumes of the first from those of the second pair of gnathopoda.

Beneath the podobranchia lies one rather small and slender arthrobranchial plume, which, from its position, I consider to be the posterior. But the examination of two specimens, one from Bermuda, and the other from the Fiji Islands, has failed to show the second or anterior arthrobranchia attached to this articulation, or a pleurobranchia either.

The second pair of gnathopoda (*i*) has a small mastigobranchia, no podobranchia, two well-formed arthrobranchiæ, and a small pleurobranchia (omitted in the plate).

The pereiopoda are similar in arrangement, but increase in strength and development posteriorly, both as regards the mastigobranchial plates and the branchial plumes, until the fifth or posterior pair of pereiopoda, where, as is common in the Macrura, the pleurobranchia alone is present, and is more largely developed than any of the anterior plumes.

The branchial arangement may be thus tabulated—

Pleurobranchiæ,	...	1	1	1	1	1	1
Arthrobranchiæ,	1	2	2	2	2	2	...
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	1	1	1	1	1	1	1
	h	i	k	l	m	n	o

Thus there are six pleurobranchiæ, eleven arthrobranchiæ (five anterior, six posterior), one podobranchia, and six mastigobranchiæ, of which the first though small is the only efficient appendage, the others being more or less rudimentary, but increasing in importance posterior to the first pair of pereiopoda.

Fig. 40.—Embryo of *Stenopus hispidus*, as seen in the ovum.

Close observation of the specimens from the Eastern and Western Hemispheres has failed to show the slightest variation, except in the curvature of the posterior pair of pereiopoda, which, in the Bermudan specimen, from which our figure is taken, has the meros bent and the carpos, so far as preserved, not multiarticulate, features which I attribute to some accident to the appendage during development.

The ova are small in size, being only 0·5 mm. in diameter, and enormous in number. An examination of the immature embryo shows there is reason to believe, from the advanced stage in which it appears, that the brephalos may quit the ovum in the Megalopa stage, which circumstance, although it does not coincide with the form of the brephalos

in *Spongicola*, demonstrates the close relation of *Stenopus* to the Astacidæ. The ova, however, are not sufficiently well preserved, nor in a condition that will enable me to satisfactorily determine the point.

Spongicola, de Haan.

Spongicola, de Haan, Crust. in v. Siebold, Fauna Japonica, p. 189, 1850.

De Haan, in his description of the characters of this genus, states as an important feature that the second pair of gnathopoda has no basecphysis—"Max 5^{arum} art. tres apicales, inflexi, breviores quam tres anteriores; art. ultimus penultimo brevior; palpi nulli;" and supports his definition by a figure in table (P) of the same work.

I am, however, able to state, after having examined a number of specimens, that there is a distinct but very short ecphysis (or palpus) attached to the second joint or basis, and that it consists of a short basal and a short terminal multiarticulate joint, the latter rapidly tapering to a point and terminating in two or three long ciliated hairs.

I only know of one species of the genus, and this appears to be abundant in its habitat.

Geographical Distribution.—This genus is found in the Chinese and Japanese seas and along the Eastern Pacific as far south as the Philippine Islands. It is stated, on the authority of de Haan, Moor, and Morgan, as well as of the naturalists of the Challenger, that it inhabits *Euplectella* and other allied genera of sponges.

Spongicola venusta, de Haan (Pl. XXIX).

Spongicola venusta, de Haan, *loc. cit.*, p. 194, pl. xlvi. fig. 9, 1850.
„ „ J. Miers, Journ. Linn. Soc. Lond., vol. xiii. p. 507, pl. xxiv. figs. 1, 2.

This species has been described by de Haan in Von Siebold's great work on the Fauna of Japan. The figure that he has given is generally too smooth. The small denticles situated on the frontal and hepatic regions of the carapace, which vary slightly in number in different specimens, are not represented. The rostrum is serrate with from eight to eleven small teeth on the upper surface, and two exist on the inferior margin near the apex.

The eyes are well developed, and placed on a moderately long peduncle.

The first pair of antennæ has the first joint of the peduncle longer than the two succeeding, and is armed on the outer surface at the base with a short, stout, flat, anteriorly directed stylocerite; the two other joints are short, the ultimate, which is the shorter, supports two flagella, of which the outer, especially in the male, is the more robust.

The second pair of antennæ has the flagellum reaching as far back as the posterior

margin of the carapace; the first three joints of the peduncle appear to have completely coalesced, and are much broader than the next two, the former on the outer anterior margin carries a large bat-shaped scaphocerite, of which the outer margin is straight and armed with five denticles; the inner is rounded and fringed with long ciliated hairs articulated at the base. On the inner and upper surface of the same joint is a short, round, translucent bulb, shown in the annexed woodcut, to which I believe de Haan refers when he says, "Antennarum inferiorum articulus primus latere interno lobo membranaceo."

FIG. 41.—Second antenna of *Spongicola venusta*.

The function or the homologue of this organ I am at a loss to determine; but it appears to pass beneath and rest on the under side of the flat lateral tooth at the base of the upper antenna.

The mandible is strong and powerful, but the incisive margin is smooth, with very slight indications of denticulation; it carries a strong, three-jointed synaphipod.

The first pair of siagnopoda (*e*) are small, feeble, and bilobed, each lobe being fringed on the inner side with short spines or stiff hairs; the outer lobe supports on the outer side a short, slender branch tipped with one or two hairs.

The second pair of siagnopoda (*f*) consists of two bilobed foliaceous rami, tipped with short hairs, a rigid but slender ramus that gradually in a curve tapers to a blunt apex, and a long thick mastigobranchia fringed with ciliated hairs that are much longer on the anterior and posterior margins, in which last position they are much increased in length.

The third pair of siagnopoda (*g*) has a broad foliaceous lobe fringed with simple hairs, a small two-jointed branch fringed with hairs on the outer margin, a long branch that is slightly curved and terminates in a few hairs at the extremity, and at the base of the latter a broad mastigobranchial plate that is divided into an anterior and a posterior portion by a transverse ridge, and is entirely free from hairs.

The first pair of gnathopoda (*h*) is long, slender, and pediform; the meros is much longer than any other joint, and straight, the basecphysis consists of a very short basal and a long, terminal joint fringed with a few ciliated hairs at the extremity. The coxa supports a small mastigobranchial plate, to which is attached a podobranchial plume of about the same length, at the base of which stands a small fasciculus of hairs.

The second pair of gnathopoda (*i* and *i''*) is long, slender, and pediform, having the ischium rather longer than the meros; the basis is short and carries a short and almost rudimentary ecphysis, of which the first joint is short and supports a terminal flagellum

that is reduced to a rudimentary condition, and it differs in this from the basecphysis of the first pair. The coxa supports a rudimentary mastigobranchia that is reduced to a membranous condition, and the podobranchia is wanting.

The first pair of pereiopoda is slender, chelate, and has the carpos very long and slender and the propodos short.

The second pair of pereiopoda is also slender and chelate, but longer and more robust than the first, it has the carpos very long, nearly as long again as the propodos, the pollex of which is straight and continuous, as is also the external margin of the dactylos; the whole appendage is sparsely fringed with long hairs.

The third pair of pereiopoda is chelate, but has the carpos short, triangulate, the propodos large and thick, the palm being nearly as broad as long, and the anterior or outer margin serrate with teeth that gradually increase in size as they approach the dactyloid articulation. Minute denticulations arm the external margin of the dactylos as well as that of the pollex; intermingled with these are a few long hairs.

The two following pairs of pereiopoda are long, slender, and terminate in a tridentate dactylos. They have the carpos longer than the propodos.

The pleon is tolerably robust, and all the somites are acuminate at the centre of the lateral margin of the coxal plates, and the telson (z) is ovate, serrate at the margins and furnished with two serrate carinæ that longitudinally traverse the dorsal surface, one on each side of the central line.

The branchial arrangement is peculiar. The plumes increase considerably in size as they recede posteriorly. The podobranchial plume is wanting in each except the first pair of pereiopoda, where a feeble one is attached to a small mastigobranchial plate. The mastigobranchial plates are present in all except the posterior pair of pereiopoda; they gradually increase in size as they proceed backwards from the first pair of gnathopoda. The arthrobranchiæ and pleurobranchiæ, which are small and almost rudimentary on the first pair of gnathopoda, increase gradually in size until the fourth pair of pereiopoda is reached; with the fifth pair the pleurobranchial plume alone is present, but that has become so much developed that it reaches to the anterior margin of the branchial chamber, (3c); that of the fourth pair of pereiopoda, as well as the arthrobranchiæ, is nearly as large, and is horizontal and anteriorly directed. The arrangement may best be seen in the following table :—

Pleurobranchiæ,	...	1	1	1	1	1	1
Arthrobranchiæ,	2	2	2	2	2	2	...
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	1	1	1	1	1	1	...
	h	i	k	l	m	n	o

Observations.—De Haan has classified this genus as belonging to the family Penæidæ,

whereas the character and arrangement of the branchiæ clearly demonstrate its approximation to the Astacidea. Mr. Miers, in his short Memoir published in the Linnæan Society's Journal, has followed the same classification, having been led to this arrangement by the three anterior pairs of pereiopoda being chelate, somewhat as they are in *Penæus*.

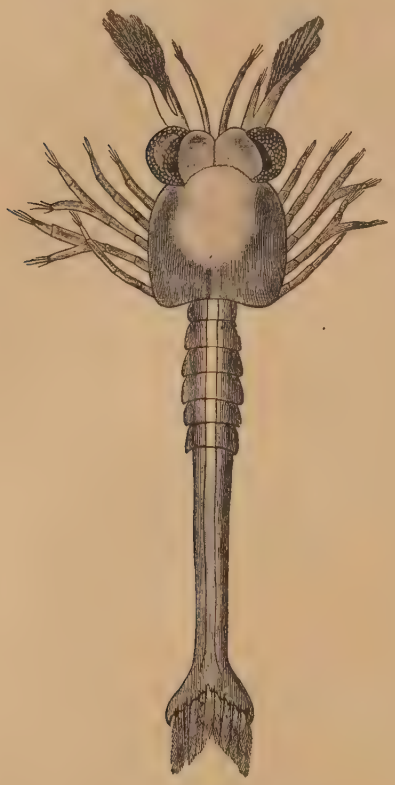

Fig. 42.—Zoea of *Spongicola venusta*, from a drawing by Dr. v. Willemoes-Suhm.

Among the numerous specimens captured some were carrying ova, and as those of one specimen had the embryo far advanced in development, I am able to give a description and a figure of the brephalos (Pl. XXIX. fig. 2), which may be compared with the annexed woodcut from a drawing of Dr. v. Willemoes-Suhm's, taken from the recently hatched animal.[1]

The eyes are large, and in the embryonic condition sessile. The anterior antennæ are uni-branched and terminate in a small joint or lobe. The posterior antennæ are two-branched, standing on a robust base or peduncle, about half the length of the first joint of the first pair; the oral appendages are visible, and the two pairs of gnathopoda are biramose and well advanced in structure. The several somites of the pereion and pleon are defined, the anterior ones being very short, and the posterior long, the last or telson is the longest, and terminates in a bifurcate or fish-tail extremity, having the posterior margin crenated and fringed with five long hairs on each side, and the lateral angles defined by a sharp tooth.

This, so far as I am able to determine, bears some resemblance to the animal which Claus[2] has figured as the Protozoea stage of *Penæus*, but which has not yet been fully determined.

Habitat.—Station 209, January 22, 1875; lat. 10° 14′ N., long. 123° 54′ E.; off Zebu, Philippines; depth, 95 fathoms; bottom, blue mud; bottom temperature, 71°. In a siliceous sponge (*Euplectella*).

[1] In a letter to Professor von Siebold (*Zeitschr. f. wiss. Zool.*, Bd. xxvi. p. lxxiv., 1876), Dr. v. Willemoes-Suhm says, "'*Palæmon* sp.,' parasite inhabiting Euplectella. Very transparent and delicate species. I succeeded to get the Zoeas out of the eggs, by keeping the mother in a globe, and found that the young one is an ordinary Zoea in which, however, some appendages are to be seen which, as a rule, come out only in a later stage." None of these have reached me among his numerous specimens of the kind, and Mr. Murray, in writing to me, says, "I cannot find any preparation of these Zoeas; in fact it is by no means sure that Suhm made any."

[2] Carl Claus, Crustaceen-System, Taf. ii. fig. 1.

Division DENDROBRANCHIATA.

This Division forms a natural and well-defined series of families that differ from the Trichobranchiata and Phyllobranchiata in anatomical structure, external form, development, and general habits, and may be divided into a Normal and an Aberrant group.

The branchial structure, instead of being developed in the form seen in the Normal group of the other two divisions, consists of a series of plumes, that in their more typical condition are attached by, or very near, their basal extremity to the animal, and from a long central stalk send off on each side a single row of branches that divide and subdivide in a more or less distinctly different manner in separate genera, and sometimes also in otherwise well-defined species.

In some genera this distinction is so great that in *Philonicus* the branchial petals on a casual inspection may be mistaken for those of a phyllobranchiate Macruran, but even here they differ in form on the same plume, being more decidedly typical of the Dendrobranchiata at the base, but falling off in character as they approach the apex.

In the Aberrantia the branchial plumes are fewer in number and more elementary in structure, but still characteristic of the division.

The nervous system exists as a series of separate ganglionic centres, corresponding to every somite posterior to the cephalic system, with the exception of that of the posterior somite of the pereion, which is absent, the nerve which supplies the fifth or ultimate pair of pereiopoda being derived from the same ganglion as that which supplies the preceding pair. Examination of several genera induces me to believe that this is a very constant character throughout the division.

Corresponding to the depreciated condition of their nerve centre, the posterior two pairs of pereiopoda are invariably of an enfeebled character as compared with the three preceding pairs, and they are never chelate in either sex during any period of the existence of the animal.

In the Trichobranchiata, as well as in the Phyllobranchiata, the ovum when liberated from the oviduct is connected with the pleopoda by a filamentous attachment, and is thus suspended until such time as the embryo is sufficiently advanced to be hatched, and to swim freely in the ocean. The brephalos appears either in the Zoea, Phyllosoma, or Megalopa stage.

In the Dendrobranchiata the form of the brephalos is unknown, except in *Lucifer*. In 1863 Fritz Müller observed great numbers of the young of Crustacea, of various forms, swimming about in the sea during the summer months. These he examined, and he was able to establish a chain of progressive forms that induced him to believe he had discovered the development of some prawn, which he supposed to be *Penæus*.

The first great link, the determination of the parent of the earliest form, was wanting, and it is remarkable that though more than twenty years have passed, not one of the

numerous observers has ever taken any specimen of the genus with ova, or procured the young animal immediately from the parent, or obtained a Nauplius, so as to establish the identity of the relationship, as has been accomplished with nearly every other group of Crustacea.

Not only is this the case, but among the large number of specimens that have passed through my hands in connection with the Challenger collection, and among all those preserved in the National Museums in London and Paris, not one specimen that I have seen carried a single ovum or even showed a trace of their attachment, yet such traces are very commonly found in the various genera in the Trichobranchiata and Phyllobranchiata of the same order.

This circumstance has led me to infer that the ova of *Penæus* and its allies are not attached to the parent or carried about as in the Phyllobranchiata, but deposited in the open waters soon after they are extruded, although Risso says[1] that *Aristeus* (*Penæus*) *antennatus* and *Penæus mars* carry their ova in July, and that those of the latter species are of an orange colour, "roux aurore."

This idea appears to receive support from the recent researches of Professor Brooks on the genus *Lucifer*, in which he shows that the ova are not attached to the parent by any viscous membrane, but appear to be entangled amongst the pereiopoda, where they remain for a day or two only, and are then hatched in the Nauplius form.

The difficulty of artificially preserving these delicate young forms in life has not yet been overcome. Those of the commonest species, and consequently we may assume the hardiest in character, have not been preserved alive beyond the second stage. It is therefore the more desirable that we should be able to determine a very close resemblance of form in order to enable us to accept the observation as conclusive.

Professor Brooks has taken the embryo from the ovum procured from *Lucifer*, and found it to be in a Nauplius condition. This fact having been established, there is no reason why the brephalos of *Penæus*, which has never been demonstrated, and which we assume to be incubated in the surface waters of the ocean, may not also be hatched in the form of a Nauplius. But Dr. v. Willemoes Suhm's observation tends to the opinion that the brephalos of *Sergestes* is hatched as *Xylaphocaris* in an eyeless condition.

These several points, namely, the variation in the nervous system, the difference in the structure of the branchiæ, the manner in which the ova are deposited, the way in which they are probably impregnated, together with the early condition of the brephalos, demonstrate clearly a broad demarcation from those families in which the gills are either trichobranchiate or phyllobranchiate. Like them they may be separated into two groups, the Normalia and the Aberrantia. The former contains the families Penæidæ and Sergestidæ, the latter, the Eucopidæ, and such Schizopoda as have the branchiæ arborescent, and hatch the brephalos in a Nauplius stage, as shown in the annexed table.

[1] Hist. Nat. des Crust. des Environs de Nice, pp. 96, 97.

	Tribe.	Family.	Subfamily.	Genus.	Brephalos.
NORMALIA.	Penæidea,	Penæidæ,		*Penæus.*	Nauplius?
				Philonicus.	
				Artemesia.	
				Haliporus.	
				Sicyonia.	
				Hemipenæus.	
				Aristeus.	
				Hepomadus.	
				? Peteinura.	
				Benthesicymus.	
				Gennadas.	
		Sergestidæ,	Sergestinæ,	*Petalidium.*	Elaphocaris?
				Sergestes.	
				Sciacarus.	
				Acetes.	
			Luciferinæ,	*Lucifer.*	Nauplius.
ABERRANTIA.	Schizopoda,	Euphausidæ,			Nauplius?
		Lophogastridæ,			
		Eucopidæ,		*Eucopia.*	
		Mysidæ,			Metanauplius.

Group NORMALIA.

The species of this Group differ considerably from one another in their appearance and general structure, but throughout these many changes there is a gradual depreciation of certain parts. Thus in the Penæidæ the anterior three pairs of pereiopoda are chelate. In the Sergestinæ there are only two, and in the Luciferinæ there is only one in this condition. The first pair loses the chelate condition in the Sergestinæ; the first and second in the Luciferinæ. The third is largest in the Penæidæ, and is the last that retains the chelate condition in the Luciferinæ, where the chela has become microscopic.

Those species that approach nearest in appearance to other groups have the posterior two pairs of pereiopoda best developed. This is well seen in *Sicyonia* and *Penæus*, but in *Benthesicymus*, *Gennadas*, and *Sergestes* they gradually diminish in size and power, and in *Acetes* and *Lucifer* they disappear altogether.

The branchiæ are well developed in the Penæidæ. They diminish in number and importance in the Sergestinæ, and disappear in *Lucifer*.

The form of the brephalos is supposed to be that of a Nauplius in the Penæidæ. It is thought to be the same in the Sergestinæ, but has not been traced nearer than an Elaphocaris with a Nauplius eye, while Mr. Brooks has demonstrated it to be of the Nauplius form in the genus *Lucifer*.

Thus widely separated as *Lucifer* may be from *Penæus*, they both possess the same structural character, the one highly developed, the other in a depauperised condition.

Tribe Penæidea.

The numerous genera which belong to the several families that form this tribe possess in common certain peculiarities of form and structure that distinguish them essentially from all others.

The earlier writers, including Professor Milne-Edwards, grouped within it all species in which the several legs posterior to the oral appendages carry more or less perfectly developed branches attached to the second or basisal joint. This he thought to be so important and distinguishing a feature, that he considered it sufficient to determine the tribe, and recently Professor Sars, in his Report on the Schizopoda of the Challenger collection, considers it as "perhaps the most striking feature distinguishing" the Schizopoda as a distinct suborder. Thus the genus *Oplophorus*, which in most other respects approximates to the Palæmonidæ, was by Milne-Edwards associated with the Penæids, as well as other less known forms, such as *Euphema*, *Ephyra*, *Pasiphæa*, &c., but which de Haan, and following him, Dana, have excluded. Still more recently, Professor Huxley, in his article on the classification and distribution of the Crayfishes,[1] has suggested the elimination of *Stenopus* also, on account of the dissimilarity of the branchial structure; and upon the same evidence the genus *Spongicola* must also be excluded.

Family Penæidæ.

The structure of the Penæidæ offers so many points of interest, that it appears to afford an instructive lesson to compare their several parts with those of the Astacidea and Caridea, so as to recognise the points in which they agree, as well as those in which they differ.

Taking the genera of this family as being the most perfectly developed of the tribe, from which others are but departures to a greater or less degree, we generally find that the animals are laterally compressed, and that this compression increases posteriorly to the last somite of the pleon.

The carapace is well developed, and laterally deeply produced; posteriorly it is carried further back at the sides than in the median dorsal line, and passes under the anterior margin of the coxal plates of the first somite of the pleon.

The dorsal median line is carinated, but in some forms the carina terminates with the posterior extremity of the rostral crest. The rostrum is always laterally compressed, and is generally long and frequently strengthened on the sides by a longitudinal ridge. In some genera, such as *Gennadas* and *Benthesicymus*, the rostrum is short, and

[1] *Proc. Zool. Soc. Lond.*, vol. iv. p. 780, 1878.

the structure of the tissue soft and membranous, but in others, where the structure is hard and rigid, the rostrum is long and slender, as in most of the species of *Aristeus*. The teeth on the rostrum, whether on the upper or the lower surface, exhibit a tendency to be constant, even in those genera where there is a considerable variation in the structure of more important organs.

In *Penæus* the teeth are generally numerous, but vary from seven or eight to twice the number, and in some species they appear on the lower margin, but more commonly they are absent from that position. In *Aristeus* three teeth are the almost constant armature of the upper surface of the rostrum, and we know of only one species that departs from this character. In *Aristeus rostridentatus* a number of small teeth arm the rostrum to the apex. In *Benthesicymus*, where the rostrum is very short, the crest is elevated, and most species carry two small teeth, but in *Gennadas* there is only one. Thus the number and arrangement of the teeth on the rostrum of the Penæidea may be considered as sufficiently constant and important to be accepted as a ready and convenient guide to the determination and classification of species.

In *Penæus* there is constantly a small tooth situated at the anterior extremity of the hepatic region, just behind the furrow that is formed by the remains of the cervical fossa. This tooth is absent in *Aristeus* in all species except *Aristeus rostridentatus*. It is present in *Benthesicymus*, and absent in *Gennadas*. In *Sicyonia* it appears as a formidable armature, and in *Solenocera* and its near allies, not only is it present, but there are others which are post-orbital and post-antennal, that appear to be constant and determining features. The frontal margin slightly recedes and has no distinct orbit, but a small tooth that overhangs the base of the first pair of antennæ defines the limit, whence the frontal margin recedes still more obliquely, and passes behind the base of the second pair of antennæ. Here is frequently situated a strong tooth that forms the anterior extremity of a strong ridge that runs backwards, and meets, without uniting with, another ridge that defines the limit between the cardiac and branchial regions. The frontal margin still recedes posteriorly until, at a short distance below, it forms another ridge that longitudinally traverses the branchial region to the posterior extremity of the carapace. This perhaps is the more constant ridge, and it is best seen in *Aristeus*, but it is reduced to a minimum in *Benthesicymus*. Although the structure of the carapace may be firm and rigid, as in *Aristeus*, the portion below the ridge is soft, flexible, and membranous; to such an extent does this exist in some species, as in *Hemipenæus semidentatus*, that the vascular ramifications may be seen in the tissues beneath.

In some species of *Penæus* very peculiar fissures may be seen traversing the carapace, one in a longitudinal direction from the orbital margin, in a slightly waved line to near the posterior margin, the other vertically, commencing near the centre of the infra-lateral margin, and passing up halfway through the branchial region. It cannot be taken

as a feature belonging to any one species, because I have seen it in two distinct forms, but I have utilised it in naming *Penæus fissurus* in order to draw attention to it.

The somites of the pleon, more particularly the first three, are each divided into two portions, an anterior and a posterior, a deep groove separating them; the posterior portion carries the coxal plate of the pleopod; it is large, broad, and anteriorly overlaps the posterior extremity of the carapace, and posteriorly the anterior margin of the second somite of the pleon. In this it differs from the species of the Palæmonidæ, in which the second somite of the pleon overlaps the one before as well as the next behind. In the Penæidæ the anterior three somites are never carinated, but those that are posterior to them are always extremely so; even when not produced to the form of a tooth, the posterior extremity of the carinated somites is longitudinally cleft for the reception of the carina of the next succeeding somite, and the telson is generally dorsally flattened or grooved, and has the sides compressed and frequently fringed with small spines and hairs.

The ophthalmopod is two-jointed, and is attached to a base that freely articulates with the frontal surface or metope, which represents the first somite of the cephalon; the first joint articulates with the somite, the second with the eye. The stalk is flattened in *Penæus*, but it is cylindrical and single-jointed in *Aristeus*, as it is in the other families of the group. In *Benthesicymus* the stalk is flattened transversely, more especially on the upper side, in conformity with the plane of the surface when the ophthalmopod is ensconced in the depression of the first pair of antennæ; and the ophthalmus or visual extremity of the ophthalmopod is very large and reniform. In some species the eyes are so arranged as to expose the surface of all the numerous lenses to the light, bringing the ophthalmopoda with their blind sides contiguous to each other. In *Benthesicymus* and *Gennadas* the visual portion of the eye is not broader than the stalk on which it stands; the pigment is reduced in many species to a small black or brown spot, and the lenses, which are few and not closely packed, are situated at a considerable distance from the spot of dark pigment. This kind of eye appears to be one of weakened power, and when at rest, or indeed at any time, has only a limited range of vision, to compensate for which some species, more especially those of the genus *Gennadas*, in which it is larger than in most others, have a supplementary eye in the form of a small tubercle which encloses a single lens. This appears to be mostly adapted to those animals that inhabit the greater depths of the ocean, where only the feeblest rays of light penetrate.

Mr. John Murray[1] has suggested that these secondary eyes may be, and probably are, phosphorescent organs, he having seen them brilliantly luminous in some species of Crustacea.

In all Crustacea above the Entomostracous forms the first pair of antennæ consists of a peduncle of three joints and two terminal flagella. In some cases the outer branch

[1] Narr. Chall. Exp., p. 743.

is reduced to a rudimentary condition, or is visible only in the brephalos stage, except in those forms, such as the terrestrial Isopoda, where the entire organ is deteriorated in character. The first joint of the peduncle is the most important of the three, since it contains the acoustic organ, and is also modified in different genera to support and protect the eye.

In *Penæus* this organ is more perfect in its several parts than in any other genus of the family group, where the tendency is generally to diminish the value of its parts. In its more perfect condition it is about one-third as broad as it is long, the form being something like a flattened cylinder; this shape is caused chiefly by the depression for the lodgment of the ophthalmopod, and the surface is thinned out accordingly; in some genera, as *Aristeus*, and some species of *Gennadas*, the depression is great; in others, as in *Sergestes* and its allies, it is almost wanting. In these genera the first joint is short, and the second and third are proportionately increased in length. In *Penæus* this joint is stout at the base where it has a free articulation with the metope; the thickness is continued on the inner side to the extremity, and the margin is straight and lies in contact with that of its fellow. Near the base of the joint on the same side, within the margin, there arises an appendage that is first laterally, and at its distal extremity vertically, compressed; it has the margins, especially towards the distal extremity, copiously fringed with hairs. In some genera this appendage, which for distinction I call the prosartema, varies in length and form, and sometimes is rudimentary or absent. In *Sicyonia* it is short, rigid, and sharply pointed. In *Aristeus* it is represented by a small tubercle supporting a tuft of hairs; while it is absent in *Benthesicymus*, *Gennadas*, and *Sergestes*.

The upper surface of the same joint, as it exists in *Penæus*, is of extreme tenuity, but the inner and outer margins are strengthened by a longitudinal rib that reaches to the distal extremity, where on the outer side it terminates in a sharp tooth or stylocerite of more or less importance, and is frequently fringed on the upper and lower sides with long hairs. This styliform tooth varies in form and length in different species and genera, being sometimes short and thick, as in *Benthesicymus*, but always terminating in a sharp point, even in *Sergestes*, where it is the least developed. In others it extends beyond the distal extremity of the joint, and frequently lies so closely in contact with the margin as at first sight to appear to be in connection with it. Between the two margins is a depression into which the ophthalmopod falls when at rest, a prosartema on the inner side overlying and protecting it, and a copious fringe of hairs surrounding it on all sides, their direction being always towards the eye. The hairs, which at the base are very numerous and closely packed, form a thick mat, protecting both that portion of the eye and also a small orifice that opens into the chamber containing the auditory apparatus, which is enclosed within a calcified fold of the external tissue. The second and third joints are generally cylindrical in form, but in *Penæus* they are rounded on

the upper side, transversely concave on the lower, and longitudinally flattened in correspondence with the surface of the preceding joint. These joints are fringed with hairs that vary in different species, but as a whole they are of little importance except as carriers of the terminal flagella.

These flagella are always two in number. In some genera they are of equal length, while in others they are unequal; they are evidently of different degrees of importance, as one is liable to vary with the sex, and is generally furnished with peculiar organs that are evidently connected with some special sense.[1] Though one flagellum may in different species vary in length it never becomes rudimentary, as the diminution is due to the shortness, rather than to the numerical decrease, of the articuli, whereas the second is always slender and constructed of articuli that are long, and the diminution generally takes place by their numerical reduction.

In an adult specimen of *Penæus japonicus*, where both flagella are short and of equal length, neither being longer than 5 mm., the primary flagellum consists of fifty articuli, and the secondary only of twenty. In *Aristeus*, the primary is very short and the secondary very long; the former is flattened and hollowed on the lower side, which latter character is emphasised in *Solenocera* to such a degree that the more slender flagellum when at rest is lodged within the longitudinal hollow of the larger.

The second pair of antennæ articulates freely with the metope, and consists of a peduncle of five joints and a long flagellum. The first joint is generally short and broad, and carries on the inner side a large phymacerite, at the extremity of which is a passage closed by a soft membrane. This is the external passage connected with the green gland, the function of which has not yet been determined. The second joint is longer but not so broad, and supports at its extremity a scaphocerite, which in this tribe of Crustacea is large, being broad, thin, and foliaceous, and on an average about one-fourth the length of the entire animal. The outer margin is strengthened by a longitudinal rib that terminates in a sharp tooth more or less distant from the distal extremity. The form varies in different genera. In some it is long and broad as in *Aristeus;* in *Sergestes* it is long and narrow, and in *Sicyonia* it is broad at the base, and gradually but obviously narrows from its greatest diameter to the apex. The scaphocerite is strengthened at the outer margin, sometimes by one, but in others, as in *Sicyonia*, by two longitudinal ribs that converge towards the extremity, where they unite and form the external distal tooth; from the inner or median rib a series of parallel ribs or raised lines run obliquely to the margin, and, when they approach it, widen and divide into two or three others. In *Penæus* the median longitudinal rib does not converge towards the subapical tooth, but runs down the centre and fades away before it reaches the distal

[1] These organs I believe to be endowed with acoustic properties, but Claus suggests that they may be olfactory organs. They are not so constant in the Penæidea as among other Crustacea, where, when present, they exist as translucent membranous cilia of variable form.

margin. The oblique ribs in *Penæus* commence near the margin and divide at a certain distance, and after a space again subdivide and terminate at the margin where a single hair articulates with every rib at its extremity. The intermediate spaces between the longitudinal ribs are occupied by strong muscles, and those formed by the marginal ribs are occupied by vessels that communicate with the hairs which fringe the inner margin of the scaphocerite; those on the outer side are upon the under surface, on the inner side of the ribs, whence they probably receive their nourishment.

This plan is best observable in *Hemipenæus* (Pl. L.), in which the circulating vessels are seen to traverse the appendage longitudinally in two lines, and to ramify over the surface in numerous capillaries that are traceable to the small direct lines leading to the marginal hairs. The joint on which the scaphocerite stands is the largest of the second pair of antennæ, and its dimensions show the importance of this appendage in the economy of the animal. Its purpose I take to be chiefly to balance the animal in a vertical position when swimming, but it appears also to be useful in folding over and enclosing or hugging objects against itself, and which may account for a condition that is met with in some specimens, the hairs being lost and the margins thickened as if diseased by much friction. In some this is increased to a larger extent than in others, and sometimes is accompanied by a constriction of the margin (fig. *c.*) that is suggestive of a permanent variation in form. On the inner distal angle in *Penæus* there is a tubercular process, which in other genera, as *Benthesicymus*, is developed into a hook with a blunt extremity, and its apex is lodged in a depression on the inner surface of the first pair of antennæ; in those species in which the process is sufficiently developed to be unciform, there is a hollow above, in the ridged structure of the under side of the stylocerite, that does not exist in those species where the process is present only as a tubercle. This hook-like process, which may conveniently be named the "ancecerite,"[1] enables the animal, by the assistance of the powerful muscles of the second pair of antennæ, to hold the first pair down more firmly than it otherwise could. In *Penæus*, where this structure exists only as a tubercle, the animal does not roll itself up as it does in *Benthesicymus*, in which the external tissues are soft, and consequently have less protection.

The three succeeding joints of the peduncle are small, and only important as being the carriers of a long and slender flagellum, that in some genera, as *Aristeus*, is three or four times as long as the animal, a feature that appears to be common to those forms obtained from very great depths.

The mandibles in all the Penæidæ are large and powerful organs; the external portion consists of an incisive margin, which is generally smooth or but slightly dentate, and beneath it a broad, circular, molar tubercle; when the incisive margins meet there is a space between them and the molar tubercles that is occupied by a process from a fleshy mass that overlies them anteriorly. The posterior process of this mass fulfils the

[1] ἀγκή, a hook.

duty of a tongue in passing and keeping the food between the grinding tubercules of the mandibles, and the portion which covers the apparatus anteriorly aids the double metastoma posterior to the mandible in enclosing the organs of mastication within a membranous orifice, whose margins undoubtedly fulfil the duties of lips. The mandibles carry an appendage which differs in form and size in several genera, but is never more than two-jointed in any genus of the tribe; generally they are larger and longer, and apparently of more importance and use, than in the Trichobranchiata or the Phyllobranchiata. In those species of Penæidea where it is large, broad and foliaceous, it suggests that the habit of the animal is, while swimming, to feed on small creatures, that are by means of these large, spreading plates directed within its mouth. I have proposed to use the term synaphipod for this appendage rather than any other suggested, because it can, I think, be readily demonstrated to be the continuation or representative of the joints of the true appendage, and not a branch of it.

The next pair of appendages is the first pair of siagnopoda, which bears a resemblance to the type of the same pair of organs as seen in the young and undeveloped forms of the Astacidea and the Brachyura. It consists of three joints, two of which are broad and foliaceous, having their inner margins fringed with hairs, while the third or outer is narrow, and in some species single-jointed and terminating in a point, in others two-jointed, the second joint tapering and tipped with a few hairs.

The second and third pairs of siagnopoda, although varying specifically in form, are yet modifications of the same general type as in other groups.

The second pair consists of three branches, two of which are flat and foliaceous, generally longitudinally divided, and having their inner free margins fringed with hairs; the third is subcylindrical, varies in length specifically, and sometimes consists of three or four joints, and on the outer margin is a broad mastigobranchial plate that varies in form in different species. The third pair perhaps undergoes more change than the second, but still retains the same fundamental plan of arrangement, consisting of one large foliaceous branch furnished on the inner free margin with hairs, a subcylindrical one formed of several articulations, and on the outer side at the base a long and broad mastigobranchial plate that is transversely divided into an anterior and a posterior portion.

The two pairs of gnathopoda are the anterior appendages belonging to the pereion, and assume a greater or less pediform character all through the tribe.

The first pair is generally broader and has the fourth joint or meros long and the ischium short; the second joint, or basis, carries a long multiarticulate branch, and the coxa supports a long mastigobranchial plate, to which a podobranchial plume is in some genera attached. The three terminal joints lie reflexed against the inner side of the preceding ones, and the inner or antagonising margin is invariably furnished with a mat of strong hairs, among which stiff spines are occasionally intermingled. The entire organ bears a close resemblance to the same appendage as it exists in the higher Brachyura.

In *Sergestes* and its congeners it is elongated and pediform, and if not the longest is certainly the most efficient appendage attached to the pereion.

The second pair of gnathopoda is long, pediform, and invariably supports a multi-articulate branch that springs from the basis or second joint, while the first or coxa carries a long mastigobranchial lash, that in *Penæus* is more or less divided in a fork-like manner; in some genera it is long and leaf-like, in others it is oval, but generally the body of the lash is supported by a stalk to which it is attached at an angle.

In many genera this lash supports a well-formed branchial plume, but it is absent in *Penæus, Sicyonia,* and *Artemesia,* whereas in *Haliporus* it is present in a reduced condition.

The first three pairs of pereiopoda are formed on the same typical plan; they gradually increase in length as they recede posteriorly, and also slightly decrease in diameter. One feature that distinguishes them from those of nearly all other forms is the great length of the carpos in relation to the propodos, and outside of this tribe, I only know of three genera, the recently found *Nematocarcinus,* belonging to the Tricho-branchiata, and *Stenopus* and *Spongicola*—genera that belong to the Phyllobranchiata, and have long been supposed to be associated with the Penæidæ—that possess this feature, which they do in each pair of pereiopoda except the third, and here the great increase of development of the chela is the apparent cause of its absence. All the true Penæidæ carry a mastigobranchial plate, while the Sergestidæ have none except in those genera where a rudimentary plate is attached to the first pair of gnathopoda. In *Penæus* and its near congeners there is no podobranchial plume, while in *Benthe-sicymus* there is one to each pair of appendages except the posterior pair. The two posterior pairs in this genus are simple, and terminate in a styliform dactylos. *Penæus* carries neither lash nor podobranchial plume, but a mastigobranchial lash appears in several other genera, but never a podobranchial plume.

In the Sergestidæ there is neither lash nor plumes attached to the legs, but the rudiments of both are sometimes attached to the first pair of gnathopoda.

The branchial arrangement in the several genera of the Penæidæ may best be appreciated by being shown in a tabulated form:—

Penæus.

Pleurobranchiæ,	.	.	.	1	1	1	1	1	1	1
Arthrobranchiæ,	.	.	.	2	2	2	2	2	1	...
Podobranchiæ,	.	.	.	...	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	1	1	1	1	1	...	...
				h	i	k	l	m	n	o

Penæopsis.

No species in the collection.

Philonicus.

Pleurobranchiæ,	...	1	1	1	1	1	1
Arthrobranchiæ,	1	2	2	2	2	2	...
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	1	1	1	1	1	1	...
	h	i	k	l	m	n	o

Artemesia.

Pleurobranchiæ,	1	1	1	1	1	1	...
Arthrobranchiæ,	1	2	2	2	2	2	...
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	1	...	1	1	1	...	...
	h	i	k	l	m	n	o

Haliporus.

Pleurobranchiæ,	...	1	1	1	1	1	1
Arthrobranchiæ,	2	2	2	2	2	2	...
Podobranchiæ,	1	r	r	...	...	...	...
Mastigobranchiæ,	1	1	1	1	1	1	...
	h	i	k	l	m	n	o

Solenocera.

No species in the collection.

Sicyonia.

Pleurobranchiæ,	1	1	1	1	1	1	...
Arthrobranchiæ,	1	1	1	1	1	r	...
Podobranchiæ,	...	...	...	...	...	...	...
Mastigobranchiæ,	1	1	1	1	1	...	...
	h	i	k	l	m	n	o

Hemipenæus.

Pleurobranchiæ,	...	r	r	r	r	r	1
Arthrobranchiæ,	1	2	2	2	2	2	...
Podobranchiæ,	1	1	1	1	...	...	...
Mastigobranchiæ,	1	1	1	1	1	...	...
	h	i	k	l	m	n	o

Aristeus.

Pleurobranchiæ,	1	1	1	1	1	1	1
Arthrobranchiæ,	1	2	2	2	2	2	...
Podobranchiæ,	1	1	1	1	1	...	...
Mastigobranchiæ,	1	1	1	1	1	1	...
	h	i	k	l	m	n	o

Hepomadus.

Pleurobranchiæ,	.	.	.	1	1	1	1	1	1	1
Arthrobranchiæ,	.	.	.	1	2	2	2	2	2	...
Podobranchiæ,	.	.	.	1	1	1	1	...	...	...
Mastigobranchiæ,	.	.	.	1	1	1	1	1	...	...
				h	i	k	l	m	n	o

Benthesicymus.

Pleurobranchiæ,	.	.	.	...	1	1	1	1	1	1
Arthrobranchiæ,	.	.	.	2	2	2	2	2	2	...
Podobranchiæ,	.	.	.	1	1	1	1	1	...	...
Mastigobranchiæ,	.	.	.	1	1	1	1	1	1	...
				h	i	k	l	m	n	o

Gennadas.

Pleurobranchiæ,	.	.	.	r	r	1	1	1	1	1
Arthrobranchiæ,	.	.	.	2	2	2	2	2	2	...
Podobranchiæ,	.	.	.	1	1	1	1	1	...	...
Mastigobranchiæ,	.	.	.	r	r	r	r	r	r	...
				h	i	k	l	m	n	o

Penæus, Fabricius.

The body laterally compressed, particularly towards the posterior portion of the animal. Carapace armed with a laterally compressed rostrum that is more or less dorsally serrated.

The ophthalmopod is two-jointed, and the eyes are large and longitudinally ovate.

The first pair of antennæ has the first joint deeply excavate on the upper surface, and furnished on the inner side with a prosartema, and on the outer with a sharp-pointed stylocerite. It terminates in two flagella, and is never longer than the carapace.

The second pair of antennæ carries a large scaphocerite, rigid on the outer margin, where it terminates in a sharp tooth, thin, foliaceous and fringed with long ciliated hairs on the inner margin. The first joint carries a small phymacerite on the inner side, and the third is furnished with a small hook (ancecerite) on the upper surface.

The mandibles are strong and powerful, smooth on the psalisiform margin, furnished with a flat, discoid, molar tubercle, and carry a large, foliaceous, two-jointed synaphipod.

The first pair of siagnopoda is three-branched, the last or outer branch being biarticulate, long, slender, cylindrical, and tapering.

The second pair is three-branched; the first branch carries a broad mastigobranchial plate, the next two are biramose and foliaceous, and the third is truncate.

The third pair of siagnopoda is five-branched. The first branch carries a broad but not very large mastigobranchial plate; the second is biramose and foliaceous, and supports externally a foliaceous ecphysis, and the terminal one is narrow, slender, cylindrical and triarticulate.

The first pair of gnathopoda is seven-jointed, short, and subpediform; the terminal three joints are reflexed, and flattened on the inner or approximating margin. The second joint or basis carries a very long two-jointed ecphysis, which has the first joint short and cylindrical, the second long, flat, multiarticulate, and fringed on each side with long ciliated hairs.

The second pair of gnathopoda is seven-jointed, pediform, and long; it frequently reaches nearly as far as the distal extremity of the ophthalmopod.

The first three pairs of pereiopoda are chelate, gradually increasing in length, and each of them carries a basecphysis.

The posterior two pairs are not longer than the preceding, are subequally slender, and terminate in simple dactyli.

The pleopoda are large and powerful, terminating in two foliaceous branches in every pair except the first, which in the male carries attached to the base a large membranous appendage that I call "petasma," which in the female is reduced to a small and rudimentary condition.

The rhipidura is large and powerful; the lateral plates are broad and foliaceous, and strengthened by a longitudinal ridge that traverses the external margin of the outer plate, and terminates in a sharp tooth.

The telson is tapering, and liable to variation in its length and armature.

Observations.—This description coincides with the first division of the genus according to M. Milne-Edwards, or with those in which the first pair of antennæ does not reach beyond the posterior margin of the carapace. As here limited the branchial arrangement differs from those species in which the flagella of the first pair of antennæ reach beyond the posterior margin of the carapace.

This genus was founded by Fabricius on the Mediterranean species, *Penæus caramotus*, which in external character is so closely allied to *Penæus canaliculatus* from Japan, described by so many naturalists, that I have accepted it as the type of my description.

Geographical Distribution.—This genus appears chiefly to inhabit the warmer seas. Species exist in the Atlantic and Pacific Oceans; in the former, ranging as far north as to be occasionally met with on the southern shores of Britain, and as far south as Brazil; in the latter, from Japan to the southern shores of New Zealand.

The Development of *Penæus* is only approximately known. Fritz Müller's statement[1] that the brephalos is a Nauplius has been fully accepted by some and cautiously received by others, and the recent researches of Professor Brooks on the genus *Leucifer* have strengthened the belief that the brephalos of *Penæus* may be in the Nauplius form also.

The observations made on the development of other forms of Macrurous Crustacea have shown that many closely associated species produce their young in very distinct stages of development. Thus the brephalos of *Crangon vulgaris* differs largely from that of *Crangon arcticus*, the former being in the Zoea, and the latter in the Megalopa stage, and that of *Homaralphæus* differs in the same degree from that of *Alphæus*, and yet the parents cannot be distinguished from each other.

Fritz Müller described a Nauplius which he found in the open sea, and supposed to be the young of *Penæus*.[2] It is destitute of distinct somites, pyriform in shape, rounded in front, 0·4 mm. in length, and 0·2 mm. in breadth at the widest part, which is just behind the head, and gradually narrowing posteriorly until at its caudal extremity the breadth is just one-fifth of the length of the animal, and it terminates on each side in one long and one short spine. In the centre of the anterior margin is a small, black, clearly defined ocellus. To the ventral surface are attached three pairs of appendages. The first is single-branched, furnished with a few simple hairs, and situated close to the frontal margin; the second is immediately behind the first, it is biramose, and has both its branches furnished with ciliated hairs. These two pairs of appendages are nearly as long as the animal, but the third pair is only half that length, and like the second it is biramose and furnished with ciliated hairs on each branch.

The animal at this stage is rather opaque and of a brownish colour, darkest towards the extremities of the appendages. It is by these little appendages that the young creature swims, lashing the water, as Fritz Müller says, like a man swimming perpendicularly with outstretched arms, and having slender willow branches in his hands.

In the next developmental stage the animal is 0·5 mm. in length. The colour and appendages are the same, but the posterior extremity of the animal is prolonged into two thick processes, at the apices of which there still exist the two long spines as in the previous stage; to these several less prominent ones have been added. The number of hairs attached to the anterior appendages has increased also. At this stage the first indication of the carapace is seen in the presence of a transverse line across the dorsal surface of the animal.

[1] Fritz Müller, Die Verwandlung der Garneelen, Erster Beitrag., pp. 8–23, Taf. xi., 1863; *Archiv f. Naturgesch.*, Jahrg. xxix. Bd. i. pp. 8–23, 1863; *Ann. and Mag. Nat. Hist.*, vol. xiv. p. 104, 1864.

[2] Fritz Müller, *loc. cit.*, p. 9, pl. xi. fig. 1.

After this stage the link is missing and the chain is again taken up when the young creature has doubled its previous length. Ten or eleven new somites are now found defined, with a pair of appendages attached to the first, the rudiments of others to the five succeeding, and with the posterior pair of pleopoda. It is now in the Zoea condition. From this period the animal can apparently be traced through the several forms that are figured in this Report to that of the adult condition.

On Pl. XLVIII. fig. 1 is that of a specimen taken and labelled "*Sergestes l.*, young, off New Guinea."

Length, 4 mm. (0·16 in.).

It was mounted and initialled by Suhm as if for especial reference. The rostrum exists as a small point, and the carapace covers the whole of the pereion. The pleon has the five anterior somites subequal and unarmed; the third somite is rather longer than the others, and dorsally slightly arched longitudinally; the sixth somite is nearly as long as the five preceding. The dorsal and ventral margins are parallel, and the telson is bifurcate, each branch terminating in two naked hairs or long spinules.

The ophthalmopoda are pyriform and well developed.

The first pair of antennæ has a peduncle of three joints, of which the first is longest, and broad at the base, but the otocyst is not yet visible, and the third supports two uniarticulate branches.

The second pair of antennæ has a peduncle that supports a scaphocerite, which increases slightly in breadth towards the distal extremity, where it is armed on the outer side with a small tooth, and fringed on the inner and distal margins with a row of fine hairs.

The mandibles are well formed but do not carry a synaphipod.

The two succeeding pairs of oral appendages are not definable in the mounted specimen, but the gnathopoda and the three following pairs of pereiopoda are, the two posterior pairs being as yet in an immature or bud-like condition. The pleopoda are present in an early stage, in a budding condition, except the ultimate pair, which has increased so as to equal in length the bifurcate telson.

I now pass to the consideration of a series of observations made by Dr. v. Willemoes-Suhm on the development of what he held to be *Sergestes tenuis*, of which the earliest stage is shown in figure 43; but a comparison of the figure with those of Fritz Müller and Claus induces me to believe that Willemoes-Suhm is mistaken in attributing it to *Sergestes* instead of to *Penæus*. I give, however, his own notes with each figure.

"C. Mature zoea. Letters as before. Length 2 mm. North of New Guinea, and on the voyage along the Marianne Islands.

"All seen on the ventral surface. 55 × nat. size. H. $\frac{1}{7}$."

Claus, in his Crustaceen System,[1] pl. ii., gives three figures of what he states to be the Zoea of *Penæus*, the second figure representing only the pleon. The telson corresponds with that in Willemoes-Suhm's figure (fig. 43), which agrees in general

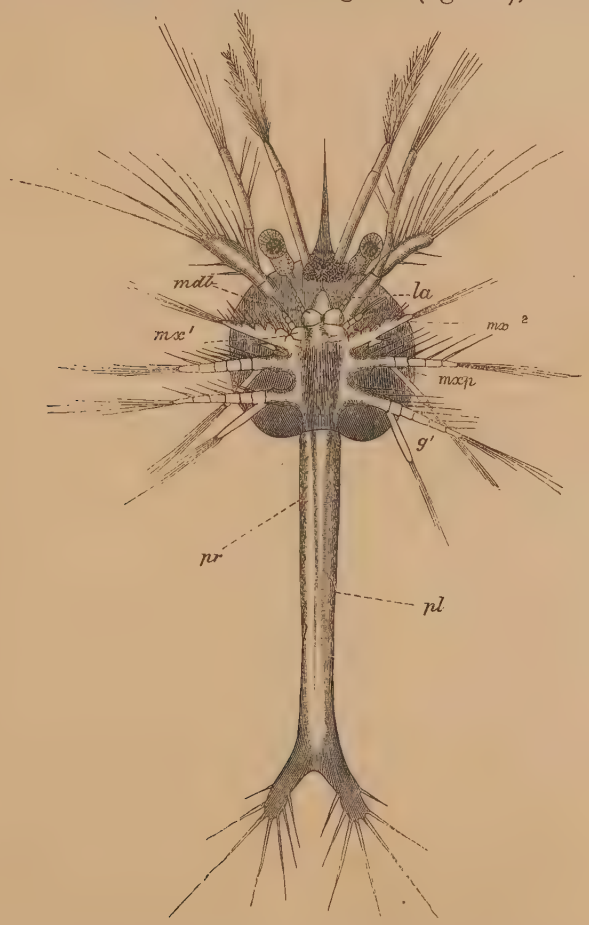

FIG. 43 (C).—Zoea of *Sergestes tenuis* (?). From a drawing by Dr. v. Willemoes-Suhm. *la*, Anterior lip; *mdb*, mandibles; *mx*[1], first maxilla; *mx*[2], second maxilla; *mxp*, maxilliped; *g*[1], first gnathopod; *pr*, pereion; *pl*, pleon.

structure with Claus's fig. 1, excepting that Willemoes-Suhm's animal has pedunculated eyes and a frontal rostrum, whereas Claus's has the ophthalmopoda sessile, without any evidence of a rostrum, and as Claus says that his fig. 2 is the same as fig. 1, only larger, we must presume that it also has the ophthalmopoda in an undeveloped condition, whereas his fig. 3 shows the ophthalmopoda largely developed, and the posterior pair of pleopoda also in an advanced condition. There is, however,

[1] Untersuchungen zur Erforschung der genealogischen Grundlage des Crustaceen-Systems, 114 pp., 19 pls. Wien, 1876.

no frontal rostrum to the carapace. It would therefore appear that v. Willemoes-Suhm's figure corresponds with one later than fig. 2 and earlier than fig. 3 of Claus.

The next figure (D) in Suhm's series (fig. 44) is labelled :—

"Development of *Sergestes tenuis*. On the larva are developed tail appendages and

Fig. 44 (D).—Zoea of *Sergestes tenuis* (?). From a drawing by Dr. v. Willemoes-Suhm. p^2, three pairs of pereiopoda. Other lettering as before.

three pairs of pereiopoda. The outer antennæ have now three joints. The scale is likewise jointed and has long hairs upon the inner side.

"Drawn from life ; nat. size, 2 mm.

"Pacific Ocean. Lat. 18°."

The animal has not increased in length. The carapace seen vertically is less circular than in fig. 43, and is furnished with a rostrum as long as the carapace. The ocellus is still present and the ophthalmopoda are longer and more club-shaped. The first pair of antennæ is three-jointed, and the second has a multiarticulate scaphocerite. The oral appendages and gnathopoda appear to be in the same relative stages as in the previous specimen, but the pereion has three pairs of appendages existing in a biramose saccular condition. The two following somites are developed, but exhibit no appearance of future appendages.

The pleon has the postero-lateral angles of each somite developed into long spines, but only the posterior possesses a pair of appendages, and these are biramose and in a saccular condition.

The telson exists as in the previous figure and corresponds with that of Claus's specimen, but the animal differs from the most advanced stage of the latter author in having a long rostrum to the carapace, and in having only three pairs of incipient pereiopoda instead of five. Claus's animal, moreover, has the postero-lateral spines attached only to the fifth somite, whereas Suhm's species has them attached to each somite of the pleon.

The next figure (fig. 45) (E) in the series is still more advanced, as shown by the following notes of the author :—

"E. The caudal appendages are further advanced, and five pairs of pereiopoda have become visible. The carapace has on each side in front one large spine.

"The eyes are large.

"The inner antennæ four-jointed.

"According to the specimen the increase is just 2·3 mm.

"Pacific Ocean. 18° lat.

"Carapace,	0·8 mm.
Pleon,	1·2 „
Rostrum,	0·3 „
Diameter of carapace,	0·56 „
Length of ophthalmopoda,	0·35 „
Width of ophthalmopoda,	0·17 „ "

In this figure the carapace is seen to have thrown out a long spine or tooth on each side at the fronto-lateral angle, and the rostrum still retains its great length.

The ocellus still continues visible, and the ophthalmopoda are longer and more clavate.

The first pair of antennæ is four-jointed, the first joint being much the longest; the second and third are short and subequal, while the fourth, which represents the future flagellum, is slightly longer than the third and tipped with three or four hairs.

The second pair of antennæ has the basal joint long and robust, the scaphocerite has lost the multiarticulate character shown in figs. 43 and 44, and has become single-

jointed; it is also figured as possessing the unusual feature of being furnished with hairs both on the inner and outer margins. The other branch is two-jointed, the first joint probably representing the terminal joints of the peduncle; the second, that of the flagellum, is tipped with four or five long hairs.

The oral appendages and gnathopoda bear the same characteristic features as are shown in the preceding figure.

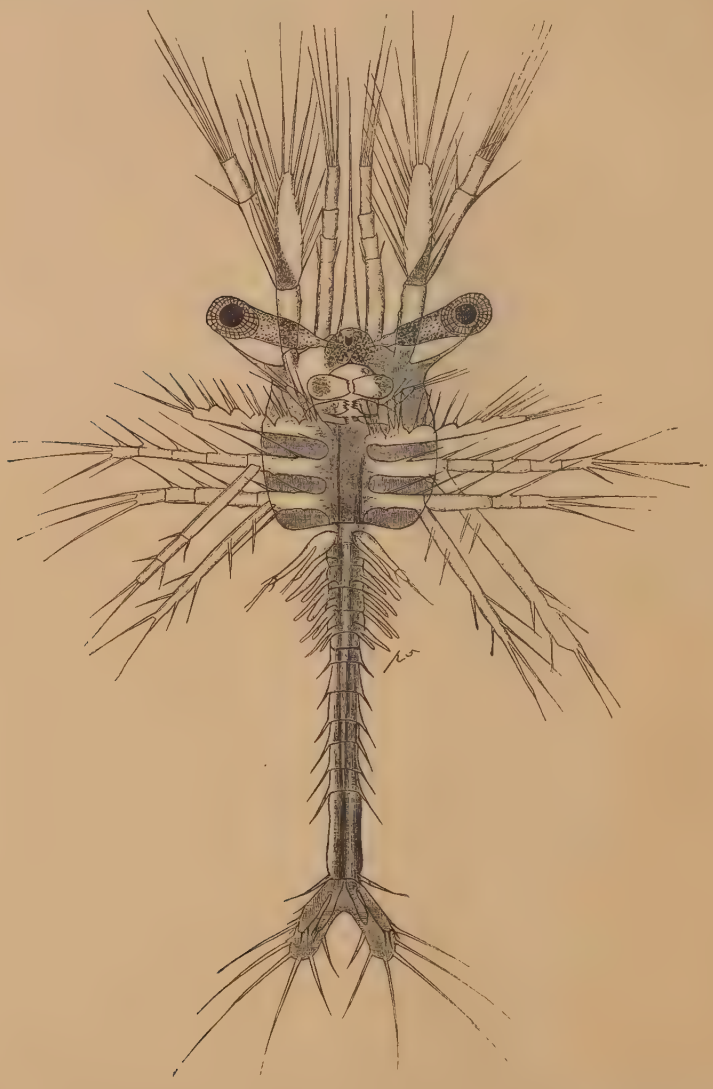

FIG. 45 (E).—Zoea of *Sergestes tenuis*. From a drawing by Dr. v. Willemoes-Suhm; p^5, five pairs of pereiopoda.

The pereiopoda have now increased to five biramose pairs, of which the first is the largest and the last the smallest.

Each somite of the pleon is armed at the postero-lateral angles with a long spine. One somite more than is normal has erroneously been figured.

None of the pleopoda are represented, even in an incipient condition, excepting the posterior pair, which is short, biramose, and furnished with a few short hairs.

This specimen was taken in the same locality as the last, and is larger by three-tenths of a millimetre.

On Pls. XLVI. (fig. 1), XLVII. (figs. 1, 2, 3), and XLVIII. (figs. 1, 2, 3, 4), are several illustrations of what I believe to be the young of one or more species of *Penæus*, or of some closely allied genus.

Although I have not had the opportunity of tracing the continuous development in the life history of the animal, I feel assured that these are the young of this or some closely allied genus. This also is the opinion of Claus concerning his younger specimens, and I believe that the three figures given from Dr. v. Willemoes-Suhm's drawings are those of the same, and not of *Sergestes* as labelled by him. Assuming this, we have a probable series in very close connection, from the earliest forms given by Claus, which correspond with the later series of figures given by Fritz Müller, to that of the adult as shown in some of the younger specimens illustrated in this Report.

Claus, in his Crustaceen System, has on pl. ii. given figures of the Zoea of *Penæus*. The first (fig. 1) is a stage earlier than the youngest given by Suhm. The third (fig. 3) corresponds with the third, or E, of Suhm. They differ in having no frontal rostrum, and in not having any spines attached to the lateral margins of the somites of the pleon as in the first and second stages, in having the ophthalmopoda undeveloped, and in having one lateral tooth on each side of the fifth somite of the pleon.

On Pl. XLVIII. (fig. 2) of this report, there is given an illustration of an animal that I consider to be the young of *Penæus* at the same stage of development as in the last of the drawings of Suhm (fig. 45) (E). It is represented as showing the dorsal surface, and therefore exhibits such features as the central spines on the somites of the pleon, and the two frontal spines which are here shown as being on the dorso-frontal surface of the carapace rather than on the margin.

Length, 3 mm. (0·12 in.).

Habitat.—Taken on the 3rd of April 1875, in the Pacific, south of Japan, between Stations 229 and 230.

Rostrum as long as the carapace. Pereion developed posteriorly to the carapace, and equal to it in length. Pleon about as long as the carapace and pereion combined. Carapace armed with two long teeth, one on each side posterior to the first antennæ, and none upon the margin.

The somites of the pereion are short, smooth, subequal, and unarmed.

Pleon dorsally armed with a sharp central tooth on the posterior margin of each

somite, of which those on the second and sixth somites are the longest. Each of the six somites is also armed on each side with a strong tooth, of which the anterior is the smallest, and the others gradually increase in length until the posterior, which is armed with two longer ones on each side.

The telson is broadly bifurcate and armed with six spine-like hairs on each ramus.

The ocellus is still visible.

The ophthalmopoda are club-shaped and well developed.

The first pair of antennæ appears to be three-jointed, and represents only the peduncle, it is narrow, cylindrical, and has the apex tipped with a few hairs.

The second pair of antennæ carries a long and well-formed scaphocerite, furnished on the outer margin with a row of short hairs, as shown in Suhm's drawing (E) (fig 45), and on the inner and distal margins with a series of longer ones.

The mandible is not furnished with a synaphipod, and the two succeeding pairs of oral appendages are not distinguishable.

The first maxillipede or third pair of siagnopoda (fig. 2, *g*) is single-branched, the posterior margin being even and unarmed, and the anterior divided into numerous lobes (six or eight), each of which supports a series of short stiff hairs, radiating perpendicularly to the surface of each lobe.

The two pairs of gnathopoda (fig. 2, *h*) are biramose and fringed with a series of delicate hairs.

The pereiopoda (fig. 2, *m*) are in an early stage of development, the anterior being the most advanced; they are biramose and tipped with a few delicate hairs.

The pleopoda are not developed, nor is the germ of one visible until we come to the sixth pair, which is formed to the extent that it reaches halfway down the telson, and is biramose, saccular, and as yet unfringed with hairs.

From the same locality is another specimen, about 2·5 mm. in length, from which the drawings of the maxillipede (fig. 2, *g*), the first gnathopod (fig. 2, *h*), and third pereiopod (fig. 2, *m*), on Pl. XLVIII. were taken. The pereiopoda are not so far advanced, and none of the pleopoda, not even the posterior pair, are distinguishable.

These two specimens are mounted on one slide, and labelled by Willemoes-Suhm, and I should have supposed it probable that his figure (E) was taken from the specimen showing the ventral surface, had he not stated that it was drawn from a specimen taken in lat. 18° N., whereas these must have been, from the date on the slide, taken in lat. 25° N.

On Pl. XLVII. (fig. 3) is a specimen possessing all the features characteristic of the genus *Aristeus*, as far as can be judged by external form only.

This was taken at Sydney, Wellington.

Length, about 6 mm. (0·25 in.).

It has the rostrum long, strong, and pointed, and armed at the base of the dorsal

surface with four strong teeth, one being posterior to the frontal margin. The carapace is produced to an angle at the infero-frontal margin and projects posteriorly beyond the pereion. The third somite of the pleon is armed on the dorsal surface with a large tooth a little in advance of the posterior margin; the fourth, fifth, and sixth are armed with similar teeth on the posterior margin, of which the one on the fourth somite is smaller than that on the third or fifth, whereas that on the sixth is larger. The telson is nearly as long as the sixth somite, which is equal in length to the four preceding somites.

The ophthalmopoda are large and pyriform. The first pair of antennæ has a three-jointed peduncle supporting two short terminal rami, of which one is biarticulate and the other uniarticulate; both are tipped with fine hairs, and at their base there is the bud of some undeveloped organ (fig. 3, *b*).

The second pair of antennæ carries a well-developed scaphocerite that is armed on the outer distal extremity with a strong tooth, and fringed on the inner margin with hairs. The flagellum is immature, being not quite so long as the scaphocerite.

The mandibles (fig. 3, *d*) are well-developed but carry no synaphipod.

The two pairs of gnathopoda are small and rather feeble.

The three anterior pairs of pereiopoda (fig. 3, *k*) are chelate, increase in length posteriorly, and each carries a long basecphysis. The fourth and fifth pairs are simple, seven-jointed, and carry a long basecphysis.

None of the pleopoda are as yet visible, excepting the sixth pair, and they are well developed and as long as the telson, which is long, slender, and forked at the extremity.

A specimen in a similar stage to that shown in fig. 3 was taken off Samboangan on October 27, 1874. It differs from that on the Plate in having the rostrum furnished with three teeth instead of four, in having the anterior extremity depressed instead of horizontal; instead of being rounded and smooth, the lateral margins of the pleonic somites are pointed and fringed with small sharp points. The pleopoda are in an incipient condition.

Fig. 2 on Pl. XLVII. represents a rather smaller specimen than fig. 3. It seems, however, to be further advanced in the development of the pleopoda, which are present in the form of small bud-like processes, but it is less advanced in relation to the pereiopoda. It is most probably the young of another species, inasmuch as it was taken in the Atlantic Ocean, off the coast of Africa, on the 10th of April 1876.

The rostrum, which is about as long as the carapace, is armed at the base of the dorsal surface, anterior to the frontal margin of the carapace, with a strong tooth.

The second somite of the pleon is armed with a long and strong tooth, projecting posteriorly, equal in length to the two succeeding somites, which are armed with a small sharp point at the posterior margin, as is also the fifth and sixth, of which four the posterior is the largest.

The telson is nearly as long as the sixth somite (fig. 2v), and is forked at the extremity.

The appendages correspond in character with those of fig. 3, excepting that the

pereiopoda are scarcely so far advanced, and the animal as a whole does not appear so mature in form, although the pleopoda are more advanced.

This specimen, together with one taken on the 20th of April, 1876, corresponds very closely with that shown on Pl. XLVI. fig. 1, which differs in having a small cusp behind the one on the dorsal base of the rostrum, in having the pleopoda more advanced in development, and in having the lateral plates of the rhipidura longer than the telson.

The following is the description of another specimen (fig. 46) taken at the surface on February 5, 1875, near Mindanao, Samboangan, Philippines, associated with *Leucifer*, and with the young of *Alphæus* and *Penæus*.

Length, 6 mm. (0·25 in.).

Carapace one-third the length of the animal, produced anteriorly to a smooth rostrum, nearly as long as the carapace, and flanked on each side of the base with a strong ophthalmic tooth; dorsally furnished on the postgastric region with a small tubercle (or the remains of a broken tooth), and armed on each side of the median line of the

Fig. 46.—Young of a species of *Aristeus* (?).

posterior margin with a long, straight, spine-like tooth; the lateral margin consists of a rigid, longitudinal border, commencing in the outer antennal tooth, and terminating posteriorly in two small marginal points or teeth.

The first somite of the pleon is dorsally smooth, furnished laterally with a pleocleis or small tooth that is directed anteriorly, and overlies the posterior margin of the carapace. The second somite is dorsally armed near the posterior margin with a strong tooth that is more than half the length of the animal.

The third somite is also furnished with a dorsal tooth, short and strong, the two next with a tooth still shorter, and the infero-lateral margin is produced to a long tooth. The sixth somite is nearly equal in length to the three preceding, subcylindrical, and armed posteriorly with a dorsal tooth and one on each side at the postero-lateral angle. The telson is short and posteriorly produced at each angle to a small tooth.

The ophthalmopod is long, subcylindrical, and has the ophthalmus scarcely larger than the peduncle.

The first pair of antennæ has the peduncle as long as the rostrum, and carries two small subcylindrical flagella.

The second pair is biramose, the scaphocerite being longer but not broader than the incipient flagellum. The oral appendages have not been determined, but the pereiopoda are subequally developed; each of the three anterior pairs has an incipient chela, while the last two are simple, and each pereiopod, like the gnathopoda, carries a long, well-developed basecphysis.

The pleopoda are all in an incipient condition, except the posterior pair, which forms the outer plates of the rhipidura, and these are long, slender, and cylindrical.

Another specimen very similar in form was taken in the Pacific on the 17th of July 1875, at Station 254; lat. 35° 13′ N., long. 154° 43′ W.

The form represented on Pl. XLVII. fig. 1, was taken in the North Atlantic, April 29, 1876.

Its length is about 10 mm. (0·4 in.), and yet in some features it appears to belong to a younger stage than either of the preceding, as will be seen by the following description:—

The rostrum is as long as the carapace and is studded throughout its whole length with small tooth-like points, and flanked on each side at the base, just over the antennal region and within the frontal margin, with a long and strong tooth. The fronto-lateral angle of the carapace is also produced to a strong spine-like tooth, and the lateral walls are produced posteriorly beyond the pereion. The pleon has each somite dorsally armed with a strong tooth, of which that on the second somite is much the largest, and is studded with small denticles similar to those on the rostrum; the others are sharp-pointed and smooth, that on the sixth somite being longer than any, except that on the second.

The telson is long and slender, dorsally flat, forked at the extremity, and furnished on each side with a small denticle.

The ophthalmopoda are well developed and pear-shaped.

The first pair of antennæ has a three-jointed peduncle, and supports two long and slender flagella that reach a little beyond the extremity of the rostrum.

The second pair of antennæ carries a broad and well-developed scaphocerite, and a long and slender flagellum that equals in length two-thirds of the animal, or twice that of the rostrum.

The two pairs of gnathopoda are developed as simple pediform appendages, and the first three pairs of pereiopoda (fig. 1 *k*) are immaturely chelate, the dactylos being produced more in the character of an immature joint, rounded and blunt at the apex: the pollex

exists as an obtuse process of the propodos, the two lying in juxtaposition, without having the characteristic movement of a chela, and the basecphysis is longer than the limb.

The posterior two pairs of pereiopoda are simple, having the seven joints visible, and support a short basecphysis.

The first pair of pleopoda is in a bud-like condition, but the four following pairs are long, slender and biramose, the branches being membranous, flexile, and free from hairs.

The posterior pair of pleopoda is well developed, armed on the outer margin near the distal extremity with a small tooth, and fringed on the inner with small hairs; it reaches beyond the extremity of the telson.

Pl. XLVIII. fig. 3, represents the rhipidura of a specimen taken in the Western Pacific.

Length, 10 mm. (0·4 in.).

This form differs from the others in having the rostrum, which is as long as the carapace, serrate towards the extremity, and it has no tooth on the dorsal crest. The pleon is armed with a strong tooth, projecting posteriorly from the third somite, all the other somites being smooth. The telson is long, with parallel sides, and becomes suddenly acuminate distally; it is fringed on the distal margin with four hairs on each side of the central point, and each lateral margin is furnished with two small points or teeth. The lateral branches of the rhipidura are scarcely as long as the telson.

The branchiæ (fig. 3*br*) are well developed. The three anterior pairs of pereiopoda possess well-formed chelæ, but shorter than the basecphysis. The posterior two pairs are simple, but short and support a long basecphysis. The pleopoda are moderately developed and well formed, and the whole animal is characteristic of a true *Penæus*, and probably becomes mature in the next stage.

Pl. XLVIII. fig. 4, represents what appears to be a mature but young form of some such species as *Penæus monodon*, or, judging from the unequal length of the two flagella of the first pair of antennæ, of *Hemipenæus tomentosus*.

Its length is 6 mm. It was taken in the surf off Samboangan.

Tracing the above series of young animals from Fritz Müller's and Claus's earlier Protozoea stage, we find that each successive form corresponds with a higher stage of development. In one or two instances, where there has been a deviation in relative size compared with the degree of development, it may be assumed that the young of larger species attain greater dimensions in their successive stages than those of smaller species. Thus it appears that we may accept the history of the progressive development of the young in a family as corresponding with that of a single genus, and if so it may be accepted as being parallel with the development of a single species.

Two links of importance are yet wanting: the one is that which connects the earliest Protozoea form with Fritz Müller's Nauplius, and the other that which connects the

Nauplius with *Penæus;* either of these being demonstrated will prove the connection, and establish the splendid hypothesis of Fritz Müller.

The recent discovery of Professor Brooks that the brephalos of *Leucifer* is a Nauplius, brings the supposition in relation to *Penæus* within the range of probability. But as the youngest form of *Sergestes* that has been observed is believed to be an Elaphocaris, and this so early that the yolk-cells were still visible, and as *Sergestes* is nearer in family relationship to *Penæus* than to *Leucifer*, I think it is advisable still to wait before asserting that the young of *Penæus* is a Nauplius.

Professor Brooks states[1] that having captured and kept in confinement a specimen, he witnessed every moult between the youngest Protozoea and the young *Penæus*, and that consequently all the metamorphoses of *Penæus* have been observed, and there is no longer any ground for the attitude which certain over-cautious naturalists have assumed in refusing to accept Fritz Müller's conclusions until more complete proof should be furnished.

Mr. Walter Faxon of Cambridge, Mass.,[2] in commenting on Professor Brooks' researches, says that the latter "has proved the connection between the stages older than the Nauplius. That the Nauplius belongs to the same series he has not shown. In fact, his youngest Protozoea is an older stage than the youngest stage secured by Fritz Müller. He has riveted the links in Müller's chain that were closely joined before, but has not touched the weak spot." Mr. Faxon further remarks that "The larval stages of Penæidæ seem to be not uncommon in the warm seas. Besides the published figures of Müller and Claus, I have seen the drawings of the developmental stages, from the Protozoea onwards, made by Mr. Alexander Agassiz at the Tortugas Islands, in 1881, and by Mr. J. W. Fewkes at the Bermudas in 1882. No observer has rediscovered Müller's Nauplius; yet in the light of our knowledge of the development of *Mysis*, *Euphausia* and *Leucifer*, I see no good ground for refusing to accept Müller's reason for believing his Nauplius and Zoea stages to be parts of one life-history."

Penæus canaliculatus, Olivier (Pl. XXXII. figs. 1, 2).

Penæus canaliculatus, Olivier, Encycl. Méthod., vol. viii. p. 660.
" " Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 414.
" " Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 174, pl. xi., 1881.

Rostrum slightly arched, furnished on the upper surface with nine teeth, the posterior of which stands on the gastric region a little unequally distant from the preceding, and one tooth on the lower margin, immediately below the most anterior of those on the upper. Dorsal carina gradually lessening to near the posterior margin, channelled in

[1] *Johns Hopkins University Circular*, vol. ii., No. 19, p. 6, 1882.
[2] General Notes, Zoology U.S., Mass., May 1883.

the median line posterior to the last tooth, and also channelled on each side, commencing at the apex of the rostrum and terminating abruptly within the posterior margin of the carapace. Pleon having the last three somites compressed and dorsally carinated, but not elevated to a tooth posteriorly. Telson acuminate and fringed with hairs at the sides. Dorsal median line longitudinally channelled to the apex.

Length, 76 mm. (3 in.) (male and female).

Habitat.—Fiji Islands.

Observations.—The specimens in the Challenger collection correspond in every detail with that described by Milne-Edwards from the Mauritius, except that the largest specimens of both males and females are only 76 mm. in length, whereas those taken at the Mauritius, and with which we have compared our specimen, were 125 mm.

Professor Milne-Edwards says that it is very like *Penæus caramote*, from which it differs in having the dorsal crest less elevated towards the base of the rostrum, and in having no tooth on the basis of the third pair of pereiopoda, and also in having none on the lateral margins of the telson. It has been frequently described by various authors, but I think that Stimpson[1] is justified in attaching "vix de-Haanii," to a specimen he records from Loo Choo.

This species differs from *Penæus caramote* in having the longitudinal ridges running parallel from near the frontal margin to the posterior extremity of the dorsal carina, whereas in *Penæus caramote* they are decidedly waved. *Penæus caramote* is also described as having twelve teeth on the dorsal crest, whereas *Penæus canaliculatus* has only nine, and the posterior is distant from the others and implanted over the gastric region. In *Penæus caramote* the stylocerite reaches to the extremity of the eye, whereas in *Penæus canaliculatus* it does not extend more than half the length.

The ventral plate or thelycum[2] in the female also differs to a certain degree: in this species it consists of two plates that meet in the central line at the posterior extremity, and gradually opens anteriorly over a projecting floor, thus forming a cavity or hollow space, whereas in *Penæus caramote* the two plates do not meet in the central line. There is also a tooth on the basisal joint of the third pair of pereiopoda in *Penæus caramote*, but none in the same position in *Penæus canaliculatus*. *Penæus caramote* has, moreover, two teeth on each side of the telson, whereas in *Penæus canaliculatus* there is none.

The coxæ of the pereiopoda on each side are not very distinct, and the fifth pair is furnished with a foramen for the passage of the vas deferens. The anterior pair of pleopoda is single-branched; attached to the basisal joint is a pair of membranous plates or curtain-like organs, the petasma, which are connected in the median line by a series of small hooks or cincinnuli (Pl. XXXII. fig. 1″ ♂). These two foliaceous plates are folded

[1] Prodromus description. anim. everteb., *Proc. Acad. Nat. Sci. Philad.*, 1866, p. 113.

[2] From θηλυκὸν, peculiar to the female.

longitudinally, and project anteriorly so that their extremity reaches as far forwards as the base of the penultimate pair of pereiopoda.

In the male specimen from Fiji the petasma corresponds precisely with that of the male taken at the Mauritius, and now in the Museum of the Jardín des Plantes.

Penæus canaliculatus, var. *japonicus* (Pls. XXXI., XXXII. fig. 4, XXXVII. fig. 2).

Penæus canaliculatus, de Haan, Crust. in v. Siebold, Fauna Japonica, p. 190.

This variety differs from Milne-Edwards's typical specimen and description of *Penæus canaliculatus* in having the telson terminating more acutely, and in having three small spines on each lateral margin, but more especially in the peculiar formation of the complementary external female apparatus which I propose to call thelycum.

Length (female), 175 mm. (7 in.). There is no male of this variety in the collection.

Habitat.—Japan.

The carapace has a central, narrow, longitudinal groove extending from the posterior extremity of the rostral carina to near the posterior margin of the carapace, and on each side another that extends from the anterior extremity of the rostrum to the posterior margin of the carapace. The rostrum is about half the length of the carapace, the dorsal crest, reaching posteriorly to nearly the middle of the carapace, is armed with nine teeth interspersed with fine hairs, and with one tooth on the under surface, situated immediately beneath the anterior rostral tooth. The two posterior somites of the pleon are laterally compressed, forming an acute dorsal angle that is produced to a small tooth at the posterior extremity of the sixth somite. The telson is centrally grooved with a longitudinal furrow that reaches from the anterior margin to the posterior extremity, and is armed with three small spines on the lateral margin.

The eyes (Pl. XXXI. *a*) are large and ovate, with the inner side flattened and the outer rounded, projecting on a biarticulate peduncle, and reaching as far anteriorly as the tooth on the inferior margin of the rostrum.

The first pair of antennæ (*b*) has the peduncle reaching as far as the apex of the rostrum; the first joint is long, wide, and scale-like; the inner margin is longitudinally straight, deepest posteriorly, where it is furnished on the inner side, near the base, with a long slender prosartema copiously fringed with hairs, and thinning anteriorly; on the outer side it is armed at the extremity with a sharp-pointed tooth, and a stylocerite lying closely against the side and directed forwards (not shown in the figure); the upper margin is longitudinally curved, and fringed with a linear row of delicate cilia, the lower is nearly straight; the outer and inner margins of the joint are subparallel, slightly approximating at their anterior extremity; the surface between the two lateral margins is deeply excavate, especially towards the base, where the auditory apparatus

lies; in this hollow the ophthalmopod rests, protected on the inner side from contact with its fellow by the thick and bushy prosartema, and on the outer by the thickly-set fringe of hairs on the margin of the joint: the second joint is short, about one-third the length of the first, longitudinally arched above and curved below; fringed on the inner and outer sides with short, thickly-packed hairs: the third or terminal joint is very short, scarcely half the length of the second, and terminates in two short, subequal, multiarticulate flagella, which are only about twice as long as the third or terminal joint of the peduncle.

The second pair of antennæ (*c*) has a very short peduncle, and all the joints articulating; the first joint is short, and on the inner side, just in front of and immediately before the mouth, it carries a phymacerite in the form of a small, circular, membranous plate; the next two joints, closely compressed together, are short and thick, and carry at their upper extremity a large scaphocerite, of which the outer margin is rigid, long, and terminating in a sharp point; the inner side is foliaceous, broad at the base, slightly tapering and rounded at the extremity, and reaches beyond the external point; the whole plate is of extreme tenuity and is longitudinally and obliquely ribbed, the lines increasing in number suddenly as they approach the margin, where they appear in connection with the several hairs of the fringe. The terminal joints of the peduncle are short, of small diameter, and are lodged on the under surface of the scaphocerite. The terminal flagellum is slender, flexible, and rather longer than the animal.

The mandible (*d*) is short and broad, having a large molar tubercle and a large, squamous, biarticulate synaphipod.

The first pair of siagnopoda (*e*) is three-jointed, two of the joints being foliaceous, and terminally fringed with spines, whereas the third is biarticulate, cylindrical, and continuously tapering.

The second pair (*f*) consists of three joints, of which the first two are biramose and foliaceous, and the third cylindrical and irregularly truncate; externally there is a broad, flat, mastigobranchial plate, anteriorly and posteriorly produced, and fringed with cilia.

The third pair of siagnopda (*g*) consists of five or six joints, of which the first two are biramose and foliaceous, increasing in size as they proceed distally; the third and following joints are cylindrical and gradually taper to the extremity. Attached to the second joint or basis is a large squamiform plate (basecphysis) projecting considerably forwards, and fringed with cilia, while attached to the first joint or coxa is another squamous plate that is broader than the preceding, projects backwards, and is fringed with fine and soft cilia.

The first pair of gnathopoda (*h*) is subpediform, having the meros long, broad and marginate: the propodos is reflexed, and, like the dactylos, which is spatuliform, is fringed with a mat of hairs and rests against the inner margin of the meros: the basis carries a long two-jointed ecphysis, the first joint of which is short, and the second long, multi-

articulate, and fringed with long ciliated hairs, and the coxa carries a mastigobranchia without a podobranchial plume.

The second pair of gnathopoda (*i*) is long, slender and pediform; it is subcylindrical; the coxa carries a biramose mastigobranchia without a branchial plume attached, but to the membranous articulation are attached two well-formed arthrobranchiæ; the basis carries a long, biarticulate ecphysis, which resembles that on the first pair of gnathopoda; the ischium is long, furred with short hairs and armed on the inner margin with a series of curved hook-like spines and corresponding fasciculi of hairs; the meros is not so long as the ischium, becomes slightly narrowed distally, and is matted with hairs on the inner surface; the carpos is longer than the propodos, which is longer than the dactylos.

The first three pairs of pereiopoda are chelate; the propodos is not broader than the carpos, but the carpos is longer than the propodos; these three pairs successively increase in length as they proceed posteriorly, a circumstance that is due to the gradually increasing length of the carpos, which in each is longer than the meros; the two posterior pairs are subequal, but simple and more slender than the preceding. The first pair is armed on the inner side of the basis with a styliform, anteriorly-directed tooth, and on the outer side with an ecphysis, which is repeated on all the succeeding pereiopoda, but the styliform tooth exists on the second pair only.

There is a biramose mastigobranchia attached to all the pereiopoda except the posterior pair, and the podobranchial plume is absent from all, as well as from the gnathopoda. The arthrobranchiæ are present, two being attached to all the pereiopoda, except the posterior pair, and one only existing on the penultimate pair, while a single pleurobranchial plume pertains to each from the first to the fifth pair. The arrangement may be represented by the following formula:—

Pleurobranchiæ, . . .	1	1	1	1	1	1	1
Arthrobranchiæ, . . .	2	2	2	2	2	1	...
Podobranchiæ, . . .	...	...	...	...	...	...	...
Mastigobranchiæ, . . .	1	1	1	1	1	...	...
	h	i	k	l	m	n	o

On the ventral surface in both our specimens, between the posterior pair of pereiopoda, is a large thelycum, consisting of a dichotomous, calcareous capsule, which extends forwards as far as the base of the antepenultimate pair of pereiopoda, whence projects two large, leaf-like, membranous appendages (Pl. XXXII. fig. 4 ♀). They appear to be connected with the internal organs by means of foramina in the floor of the capsule, and have no connection whatever with the fifth pair of pereiopoda.

The five anterior pairs of pleopoda are formed on one general type. They consist of a large triangulate basisal joint attached to the ventral surface of the pleon, and terminating in two leaf-like branches, both of which are smooth in the median and posterior portions, but strong and multiarticulate at the margins, which are posteriorly

fringed with hairs; the outer branch is always the larger and more conspicuous in the anterior pairs, the inner gradually lessening in proportion as it advances until it is little more than rudimentary in the first pair.

The sixth pair of pleopoda forms the outer plates of the rhipidura: the basal joint is short, the outer plate is longer than the inner, and the inner is longer than the telson, and both graduate towards the outer distal angle of the external branch.

Observations.—Both our specimens, which were purchased in the market at Yokohama, are females, and have the very peculiar apparatus on the ventral surface between the posterior pair of pereiopoda, which, so far as I am aware, has never been previously figured or described by any naturalist.

The female of a variety taken at Port Jackson agrees with the Japanese form in every detail excepting that the thelycum consists of two oval plates attached in their entire width, at the posterior extremity to the ventral surface of the pereion, and at the anterior by a narrow process on the outer side only. This organ differs in form from the thelycum in the Japanese variety. I have only examined females of this species, and my experience of this peculiar apparatus is not sufficiently extensive to enable me to say whether or not it undergoes any change or modification of form or of growth on the approach of the power of reproduction.

Penæus canaliculatus, var. *australiensis*, nov. (Pl. XXXII. fig. 3).

This variety corresponds closely with the preceding, but differs in the form of the thelycum, which may be better understood by the figure on the plate than by a written description. There are, moreover, plates on the ventral surface, between the third and fourth pairs of pereiopoda, that are not apparent in the typical varieties.

There is not a male of this variety in the collection.

Length (female), 100 mm. (4 in.).

Habitat.—Port Jackson, Australia; depth 2 to 10 fathoms; April 1874.

Penæus indicus, Milne-Edwards (Pl. XXXIII. fig. 2).

Penæus indicus, Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 415.
„ „ Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 177, pl. xii. fig. 5.

Rostrum straight, just passing beyond the extremity of the peduncle of the first pair of antennæ, styliform towards the extremity, and surmounted at the base by a crest that gradually decreases towards the posterior margin of the carapace. Armed with eight ("or nine") teeth on the dorsal surface, and four or five on the inferior. Flagella of the first pair of antennæ slender and equal in length to their peduncle. Telson about half the length of the outer branch of the rhipidura, terminating in a sharp point, with

the dorsal surface longitudinally grooved in the median line, and the lateral margins fringed with cilia.

Length, 127 mm. (5 in.) male.

Habitat.—Station 203, October 31, 1874; lat. 11° 6′ N., long. 123° 9′ E.; depth, 20 fathoms; bottom, mud. One specimen; trawled.

The specimen in the Challenger collection appears to correspond more closely with the description that Milne-Edwards has given of the species than does the typical specimen preserved in the Museum of the Jardin des Plantes, of which I have given a figure in the Ann. and Mag. Nat. Hist. for September 1881. In the type the rostrum is slightly elevated at the extremity, and the crest at the base is not remarkable, whereas in our specimen the rostrum continues in a horizontal line to the apex, and the crest is strongly marked at the base. Our specimen is a male, while that of Milne-Edwards is a female. The Challenger specimen has eight teeth on the dorsal margin, of which the most anterior is small, and there are four on the lower margin. The rostral carina gradually decreases to the posterior margin of the carapace.

The posterior three somites of the pleon are compressed, and the last two are carinated.

In our specimen the sixth somite terminates in a small tooth, but in Milne-Edwards' specimen the tooth is somewhat larger.

The ophthalmus is moderately large and stands on a long ophthalmopod, of which the first joint projects laterally. The first pair of antennæ has slender flagella, the longer of which is slightly longer than the peduncle, which is subequal with the rostrum. The prosartema reaches beyond the ophthalmopod, and the stylocerite does not extend so far as the extremity of the eye. The second pair of antennæ has a flagellum that is long, slender, and twice the length of the animal, and the scaphocerite reaches a little beyond the extremity of the rostrum. Milne-Edwards remarks that the chelæ of the three anterior pairs of pereiopoda are long and slender, but they do not appear to be remarkably so beyond those of other species. In our specimen the petasma corresponds with the same organ in *Penæus monodon*. And in all other respects I can find no definite separating feature beyond the existence of one little tooth at the anterior extremity of the rostrum, and another on the inferior margin. In the larger specimen, that is, in *Penæus monodon*, the first pair of antennæ has the outer flagellum much thicker at the base, but this is only a feature characteristic of a matured male. The longitudinal grooves on the inner and outer plates of the rhipidura are similar; and the telson and the details of the structure throughout appear to be identical.

Our only specimen that corresponds with Milne-Edwards' description of *Penæus indicus* is a male, and was taken, associated with two large females of *Penæus monodon*, among the Philippine Islands.

The ventral plate or thelycum in the female, from which Milne-Edwards drew his

description, is very similar to the same organ in *Penæus monodon*, and taking all things into consideration, I am induced to believe that *Penæus indicus* is but an overtoothed variety of *Penæus monodon;* it is interesting as showing from what small variations forms of importance may gradually proceed.

Penæus monodon, Fabricius (Pl. XXXIV. fig. 1).

Penæus monodon, Fabricius, Suppl. Ent. Syst., p. 408.
Penæus monodon, Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 416.
Penæus semisulcatus, de Haan, Crust. in v. Siebold, Fauna Japonica, p. 191, pl. lvi. fig. 1.
Penæus carinatus, Dana, U.S. Explor. Exped., Crust., p. 602, pl. xl. fig. 2.
Penæus monodon, Sp. Bate, Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 178, pl. xi., 1881.

Rostrum straight, dorsally elevated into a laterally compressed crest that is armed with six or seven teeth, and on the lower margin with three. Rostral crest gradually lessens behind the last tooth, and is lost before reaching the posterior margin of the carapace; in the male it exists in the form of a simple carina, and in the female it is longitudinally grooved. On each side of the rostral crest is a sulcus, formed by a longitudinal ridge that commences at the apex of the rostrum and terminates in a line corresponding with the posterior tooth of the dorsal crest. There is one tooth on the basisal joint of the anterior two pairs of pereiopoda and none upon that of the third. The telson is grooved in the median line and fringed with fine hairs on the margins.

Length, 190 mm. (7·5 in.).

Habitat.—Station 188, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; south of New Guinea; depth, 28 fathoms; bottom, green mud. Two specimens; a male and a female; associated with *Penæus incisipes.*

Station 203, October 31, 1874; lat. 11° 6′ N., long. 123° 9′ E.; off Panay, Philippine Islands; depth, 20 fathoms; bottom, mud. Two specimens; females, associated with a male of *Penæus indicus;* trawled.

The typical specimen of Fabricius of this species is not now in existence, and those from which Milne-Edwards drew up the short description in his Histoire Naturelle des Crustacés, are all small and immature animals, but he says that although he had not seen specimens that were more than 76 mm. (3 in.) in length, yet according to Fabricius they reach to a very large size.

The examination of the specimens preserved in the Museum of the Jardin des Plantes, and their comparison with others of a larger size, have convinced me that *Penæus monodon* is identical with *Penæus semisulcatus* of de Haan, as figured and described by him in Siebold's Fauna Japonica. De Haan rests the distinguishing feature, that separates the two species, on there being a median longitudinal groove between the base of the rostrum and the posterior margin of the carapace in *Penæus semisulcatus*, and none in *Penæus*

monodon, whereas in the specimens now under our observation in the Challenger collection, taken in the same haul, the female has a median groove, but in the male there is none, the dorsal carina being entire.

There are, however, some minute details that are at variance, although not sufficiently important to justify specific separation.

Both *Penæus monodon* and *Penæus semisulcatus* carry three teeth on the lower margin of the rostrum, but according to de Haan's figure they are situated, or at least two of them, posterior to the most anterior tooth on the upper margin, whereas in our specimens of *Penæus monodon*, they are all in advance of that position. In de Haan's figure there is also shown what may be considered as a supraorbital tooth, but judging from the specimens I have examined, it is rather the result of a somewhat sudden curve or bend in the orbital margin than a distinct tooth.

Desmarest has evidently mistaken the species, for he says that it has seven teeth on the upper margin of the rostrum and five below. Milne-Edwards says that it has eight or nine teeth above and three below; and de Haan says that it has eight teeth on the upper margin and three below. In the Challenger collection there are four specimens, all of them adult. Three of these are females and one is a male. The females have seven teeth on the dorsal crest, the male six, and all have three below. Mr. Miers,[1] of the British Museum, says in relation to this species that he thinks it to be synonymous with de Haan's species, *Penæus semisulcatus*. Moreover, he says, "In two specimens from Australia (Shark Bay) and one from Ceylon, the rostrum is 6–7-toothed above, the teeth towards the apex separated by much wider intervals than in the other specimens referred to *P. semisulcatus*, there is a short dorsal carina which does not reach to the posterior margin of the cephalothorax, and is not canaliculated above, and the gastro-hepatic sulcus is very deep and strongly defined." For the latter he proposes the name of *Penæus monodon* if the two species be distinct.

Such a difference can scarcely be recognised as a specific character, for the greater enlargement of the interdental spaces may be and probably is induced by age, sex, or local variation; and, as I have shown above, the postrostral groove cannot be accepted as more than a collateral feature, since it is found in the females and not in the males of the same species.

The flagella of the first pair of antennæ are subequal, whereas *Penæus semisulcatus* is described by the author as having the internal branch twice the length of the external.

De Haan described the female as having the sternum between the posterior pair of pereiopoda divided by a median cleft and reflexed. ("Sternum feminarum inter pedes quintos rima media continua divisum et reflexum.") These exist as two flattened calcified plates—which I distinguish by the name of thelyca—extending from the base

[1] *Proc. Zool. Soc. Lond.*, p. 299, March 5, 1878.

of the fourth pair of pereiopoda to the posterior margin of the sternum; the inner margins are brought into contact and turned downwards, and form the cleft of which de Haan writes (*vide* fig 1‴, ♀). The oviducts open at the base of the coxæ of the third pair of pereiopoda by a foramen placed at the extremity of a short tubercle, the margin of which is copiously fringed with hairs. The first pair of pleopoda has the outer ramus long, flat, and subfoliaceous, and the inner reduced to little more than a rudimentary bud.

In the male the two oval plates are not present, but a small sharp prominence exists in the median line towards the anterior portion of the ventral surface of the posterior somite. The vas deferens debouches near the base of the coxa, where that joint articulates with the pereion.

The first pair of pleopoda has the external ramus similar to that of the female, but the inner branch is altogether altered from its normal form and condition. It articulates with the basisal joint near its base, and is developed into a large, membranous and flexible plate, longitudinally folded on itself, and united with its fellow in the median line by a series of small cincinnuli, which thus form a large petasma that overlies the sexual apparatus.

The other pairs are biramose, but have the outer branch twice as long as the inner.

Milne-Edwards records his specimen from the coast of India, and Siebold obtained that which de Haan described from Japan.

Rather than multiply species upon grounds of slight variation, I have thought that as *Penæus monodon* has never been figured, and varies in some points in almost every description, and as the Challenger specimens so closely resemble *Penæus semisulcatus*, and correspond with the description given by Milne-Edwards and de Haan, they may be accepted as the typical form of the species.

Dr. Camil Heller, in his account of the "Novara" Crustacea, has described a species under the name of *Penæus tahitensis*,[1] the figure of which varies but little from this species, but the description does not agree with his figure. He says that the inferior margin is without teeth ("margine inferiore edentulo"), but represents three teeth in his figure; he also says that the flagella reach to the last tooth on the rostrum, but figures them as being as long as the carapace. If the figure be correct, the species corresponds very closely with that given by Dana as *Penæus carinatus*, and which I think there is little doubt is identical with *Penæus monodon*. The extremity of the rostrum is very slightly turned up in both de Haan and Dana's specimens, whereas in the type according to Milne-Edwards the rostrum is straight, and the Challenger specimens agree with this.

Heller's species is 120 mm. in length, and was taken off the Island of Tahiti, while Dana's *Penæus carinatus* was taken near Singapore.

Penæus esculentus, Haswell, taken at Port Jackson, probably belongs to this species also.

[1] Reise der Fregatte "Novara," Crustacea, p. 121, Taf. xi. fig. 2.

Penæus velutinus, Dana (Pl. XXXIII. fig. 1).

Penæus velutinus, Dana, U.S. Explor. Exped., Crust., p. 604, pl. xl. fig. 4.

Body tomentose. No carina on the posterior half of the carapace. Rostrum straight, lanceolate, the lower margin smooth, ascending anteriorly to the extremity, armed on the upper margin with eight equidistant teeth, and one posteriorly remote. Pleon dorsally carinated from the second somite to the posterior extremity of the sixth, which terminates in a small tooth. Eyes short, large, ovate. Peduncle of the first pair of antennæ reaching as far as the extremity of the rostrum. Flagella short, not longer than the last two joints of the peduncle. Scaphocerite of the second pair of antennæ not extending beyond the rostrum. First pair of pereiopoda armed with one tooth on the basis, and one on the ischium, second pair with one on the basis. Telson as long as the outer ramus of the rhipidura, not carinated nor channelled, terminating in a sharp styliform point, and armed on each side with four long, articulated spines and one rigid spiniform tooth.

Length, 75 mm. (3 in.).

Habitat.—Station 188, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; south of New Guinea; depth, 28 fathoms; bottom, green mud. Twenty-five males, eighteen females, two young.

Station 184, August 29, 1874; lat. 12° 8′ S., long. 145° 10′ E.; between Australia and New Guinea, near Torres Strait; depth, 1400 fathoms; bottom, Globigerina ooze; bottom temperature, 36°. Two specimens; females. Length 36 mm.

Station 186, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; between Cape York and Arrou Islands; depth, 8 fathoms; bottom, coral mud. Two specimens, a male and female. Length, male 40 mm., female 58 mm.

Station 187, September 9, 1874; lat. 10° 36′ S., long. 141° 55′ E.; Torres Strait; depth, 6 fathoms; bottom, coral mud. Two females, of a redish hue. Length of largest, 64 mm.

Station 190, September 12, 1874; lat. 8° 56′ S., long. 136° 5′ E.; south of New Guinea; depth, 49 fathoms; bottom, green mud. Twelve females, seven males. Length, male 62 mm., female 44 mm.

Near Station 190, between that and 191 (September 18, 1874), a single specimen was taken with *Penæus anchoralis*.

Station 233, May 17, 1875; lat. 34° 39′ N., long. 135° 14′ E.; channel between the Japanese Islands; depth, 8 fathoms; bottom, mud. Eleven females, ten males. Length 65 mm.

Station 234, June 3, 1874; lat 32° 31′ N., long. 135° 39′ E.; depth, 2675 fathoms; bottom, blue mud; bottom temperature, 35°·8. Two females. Length, 60 mm.

The body of the animal is covered over with a short, velvety pile, more scanty, apparently from friction, upon the sides of the posterior somites of the pleon and the lower part of the walls of the carapace. There is no crest on the dorsal surface of the carapace posterior to the last tooth of the rostrum, which is armed with seven teeth in the male and eight in the female that are equidistant, the last of the series terminating in a line with the orbital margin of the carapace, and one tooth being separated from the rest, standing on the gastric region.

On the pleon the evidence of a dorsal carina commences on the second somite and increases posteriorly on each successively until it forms a very distinct and perfect carina, which terminates in a short tooth at the extremity of the sixth somite, and is indicated at the posterior extremity of the two preceding somites.

The ophthalmus is large, reniform, and stands on a short biarticulate peduncle.

The first pair of antennæ is longer than the rostrum, being subequal to the length of the peduncle, and supports two short flagella which are not so long as the last two joints of the peduncle. The basal joint carries a prosartema that reaches to its distal extremity, and a sharp-pointed stylocerite that extends beyond it.

The second pair of antennæ has the first three joints of the peduncle consolidated into one, which articulates with the surface of the metope, and carries a scaphocerite, and the terminal joint supports a flagellum that is twice as long as the animal.

The mandible is a stout, short and powerful organ, and supports a quadrate, biarticulate synaphipod, broader and shorter than that of *Penæus canaliculatus*, smooth and evenly polished on the external surface, and projecting forwards, as a foliaceous plate, to overlie the base of the second pair of antennæ. The metastoma consists of two oblong plates lying against the posterior surface of the mandible.

The first pair of siagnopoda does not carry a long, slender, biarticulate outer ramus as in *Penæus canaliculatus*.

The second pair of siagnopoda corresponds closely with that of the preceding species, but has the posterior extremity of the mastigobranchial plate somewhat broader.

The third pair differs little from the typical form in the genus.

The first pair of gnathopoda likewise differs little from the typical generic form. The second pair carries a small, sharp tooth at the anterior extremity of the basis.

The first pair of pereiopoda is armed with two teeth, one on the inner anterior extremity of the ischium, and another in a similar position on the basis; this latter joint carries a short and slender basecphysis, and the coxa carries a short pedunculated equi-biramose mastigobranchia.

The second pair of pereiopoda is longer than the first, and is armed with one long and slender tooth on the basis, which also supports a short and slender basecphysis, and the coxa supports a pedunculated inequi-biramose mastigobranchia.

The third pair of pereiopoda is longer than the preceding, it does not carry any tooth, but the basis supports an ecphysis, and the coxa carries a single-branched mastigobranchia, which is pedunculated, broad at the base, and tapering. The oviducts are attached to the coxal joints in the form of a projecting tubercle directed obliquely inwards and posteriorly.

The fourth and fifth pairs of pereiopoda are long, tolerably robust, and terminate in long, flattened, lanceolate dactyli; each carrying a basecphysis but no mastigobranchia.

On the ventral surface (fig. 1‴) between the second pair of pereiopoda, two long spine-like teeth project, one on each side of the median line, and between the last two pairs lies a cordiform thelycum, flat in the middle, elevated, and surrounded by a margin fringed with hairs.

The anterior pair of pleopoda (*p*) has the outer branch long, flattened and tapering, the inner minute and rudimentary, and situated near the inner distal angle of the basisal joint. The four following pairs are subequally biramose.

The male differs very little from the female in general aspect. The several parts appear to be a little more pronounced, but the two long and slender teeth, so conspicuous on the ventral surface in the female, are wanting.

The vas deferens projects from the posterior pair of pereiopoda, and the petasma (fig. 1″, *p*) attached to the first pair of pleopoda springs from near the base of the basisal joint, and is produced into a longitudinally folded leaf-like appendage, intimately linked together in the median line by small cincinnuli. All the other pairs are similar to those in the female; the sixth pair, which aids in the formation of the rhipidura, is long, narrow, and rounded at the extremity.

The telson (1z) is as long as the lateral plates, furnished on each side with four spines, and one spine-like tooth, and terminates in a long and slender point.

Forty-five specimens of this species were taken both with the trawl and the dredge south of New Guinea, and several others at different Stations in the same region, associated in some instances with *Polycheles;* and twenty-one were dredged in the narrow channel between the islands on the southern coast of Japan.

Stimpson records specimens from Japan, at from 4 or 5 to 30 fathoms, on a sandy bottom.

This species is essentially an inhabitant of shallow water, and as such was found in the channel referred to, where the water is only from 8 to 50 fathoms deep, a depth that corresponds with that of most of the other recorded localities. The great variation in the depth at which two specimens were taken in the same region can only be accounted for by the fact that the deep water comes up close to the southern shores of Japan. I am therefore induced to believe that those obtained from the greater depth of 2675 fathoms were caught swimming in mid-water, and carried down previously to their being brought up in the dredge, a supposition that is supported by their soft and somewhat damaged condition.

This species, since first described by Dana, does not appear to have been identified by any naturalist except Stimpson; it is so much like *Penæus affinis*, Milne-Edwards, that it has probably been mistaken for it, as in general appearance the species correspond.

Penæus barbatus, de Haan,[1] differs from it in the number of teeth on the rostrum, which is figured with eight, the posterior of which is distant from the others and described "Rostro margine . . . ., superiore 5–7 dentato;" the greater length of the flagella of the first pair of antennæ, and in having "Pedes tres antici basi unispinosi;" a circumstance that separates de Haan's species from those that I have described (as *Penæus velutinus*) from off the southern coast of Japan. They may however with certainty be distinguished by several important points, of which the following are the most conspicuous.

The rostrum in *Penæus velutinus* is not quite so long in relation to the length of the carapace, the denticulation on the upper surface is deeper and closer, and the rostrum greater in depth and less styliform at the extremity. The flagella of the first pair of antennæ are shorter. The first pair of pereiopoda is armed with two strong teeth, and the second pair with one. In the female two long slender teeth project from the ventral surface of the somite between the second pair of pereiopoda; which, together with a variation in the form of the petasma attached to the first pair of pleopoda in the male, are decided points of specific separation.

Dana dredged his specimen off the Sandwich Islands, but records it as being only one and three-quarters of an inch long, or about one-half the length of those taken by the Challenger, excepting in the case of a few young ones, which I presume Dana's specimen must have been.

At Station 190 numerous specimens were taken, ranging in sizes from 25 mm. to 75 mm. The adult male corresponds with that of our type, except that it has the longer branch of the petasma tipped with radiating points; in the younger forms the extremity of that organ is smooth and not prolonged, and in a still younger male the two branches are separate and narrow. The females also correspond with the same sex in the typical specimens, except that the two spinous teeth between the second pair of pereiopoda are short in the younger specimens, and in some they appear to be absent.

These may be recognised as a variety under the name of *radiata*.

The following species exhibit a resemblance in external form to *Penæus velutinus*, the variation in the number of teeth on the rostrum being inconsiderable, and in my opinion of secondary importance, and they each carry a solitary tooth planted on the gastric region, varying a little in position, being more or less distant from the posterior tooth on the rostrum. Notwithstanding this general similitude there are certain important details that appear to me to be neither directly or immediately transmit-

[1] V. Siebold's Fauna Japonica, Crustacea, p. 192, *Penæus barbatus*, pl. xvi. fig. 3.

table. I have arranged these several species in a tabular form so that the points of resemblance and separation may be the more readily appreciated, merely premising that the petasma in the male and the thelycum in the female are constant in the same and dissimilar in separate species.

Species.	Rostral Teeth.	Gastric Tooth.	Telson.		Ventral Teeth.	Hepatic Tooth.	1st Pereiopod Teeth.	2nd Pereiopod Teeth.
			Teeth.	Spines.				
Penæus velutinus, . .	8	1	1	4	2 ♀	1	2	1
Penæus incisipes, . .	7 to 9	1	0	0	0	1	1	1
Penæus affinis, . .	8	1	0	0	(?)	1	(?)	(?)
Penæus anchoralis, . .	6 to 9	1	0	1	0	1	1	1
Penæus philippinensis, . .	7	1	1	3	0	1	2	0
Penæus fissurus, . .	6	1	1	0	0	1	2	0
Penæus rectacutus, . .	12	1	(?)	2	0	1	2	0
Penæus monoceros, . .	8	1	0	0	(?)	1	(?)	(?)
Penæus serratus, . .	12	1	1	2	0	1	2	0

Penæus incisipes, n. sp. (Pl. XXXIV. fig. 2).

Rostrum straight, slightly elevated, armed with seven to nine teeth on the upper surface, and one on the gastric region. Eye large, about half the length of the rostrum.

First pair of antennæ having flagella as long or nearly as long as the peduncle. Second pair of antennæ three times as long as the entire animal. First pair of pereiopoda armed with one tooth. Second pair armed with one; third with none. Chelæ long and slender. Posterior pair of pereiopoda long and slender, dactylos flattened, meros notched on the under or posterior margin. First pair of pleopoda in the male having the petasma long, narrow, and double-headed at the extremity; second pair furnished with a large tubercle on the anterior surface of the inner ramus; telson unarmed and shorter than the outer plates of the rhipidura.

Length of male, 88 mm. (3·5 in.). Female, 31 mm. (1·25 in.).

Habitat.—Station 190, September 12, 1874; lat. 8° 56′ S., long. 136° 5′ E.; Arafura Sea, south of Papua; depth, 49 fathoms; bottom, green mud. One female.

Station 203, October 31, 1874; lat. 11° 6′ N., long. 123° 9′ E.; off Panay, Philippine Islands; depth, 20 fathoms; bottom, mud. Three males and one small female.

The specimens of this species in the collection are three males, and two small females; they are smooth and almost polished, and tomentose in patches corresponding with various regularly situated elevations and depressions that mark the animal all over. The rostrum

is straight and almost in a horizontal line with the dorsal surface of the carapace, rising to the apex. The type specimen is armed with seven teeth, but the extreme tip of the rostrum is broken off. Two others, not quite so large, have nine each, the apical one being very small; the last is above and behind the orbital margin of the carapace, and one posteriorly remote upon the gastric region, whence the dorsal crest is continued with but a minimum of elevation to the posterior margin of the carapace. Two longitudinal ribs traverse the carapace in a slightly oblique direction, just above the branchial region. The orbital tooth is very minute, while the antennal tooth is well formed and prominent, as also is the tooth on the hepatic region.

The pleon is marked with a median longitudinal carina that is visible on the dorsal surface of the second somite, and gradually increases to a small ridge on the sixth somite, where it ends abruptly and is not produced to a tooth. The sixth somite is compressed laterally, and so to a less extent is the fifth. The telson is dorsally longitudinally grooved, and the sides ribbed, smooth, and fringed with fine hairs, and the extremity terminates in a sharp point.

This species differs from the type specimens of *Penæus affinis*, preserved in the Museum of the Jardin des Plantes, as described by Milne-Edwards, in having the rostrum straight, instead of being curved upwards at the extremity.

The notch on the meros of the fifth pair of pereiopoda is equally distinct, but that on the rhipidura is less marked. There is a slight variation also in the folding of the petasma.

The females in the collection correspond with the males, except in the absence of the peculiar excisions on the base of the fifth pair of pereiopoda, and on the outer plates of the rhipidura. The female specimens are small and probably immature, being only 31 mm. in length.

In the female the thelycum or ventral plate is shaped like the conventional figure of a heart, with the apex directed anteriorly.

The resemblance of this species to the type, *Penæus affinis*, is so great, that in spite of the various differences, I have some hesitation in considering it anything more than a modified form.

Penæus anchoralis, n. sp. (Pl. XXXV. fig. 1).

Surface tomentose. Rostrum dorsally horizontal, slightly elevated at the apex and armed with eight small teeth, subequally distant, and one small one further separated and situated on the gastric region. Lower margin smooth, gradually ascending in a curved line to the apex. Frontal margin armed with a small supraorbital and an antennal tooth, and one on the hepatic region. Third and succeeding somites of the pleon carinated, the sixth terminating in a small tooth. Telson pointed, dorsally flattened and

longitudinally grooved, fringed at the margins with fine cilia, amongst which one small spine is visible on close inspection.

Length—female 88 mm. (3·5 in.); male, 63 mm. (2·5 in.).

Habitat.—Station 188, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; Arafura Sea, south of Papua; depth, 28 fathoms; bottom green mud. Six males and one female.

Station 190, September 12, 1874; lat. 8° 56′ S., long. 136° 5′ E.; Arafura Sea, south of Papua; depth, 49 fathoms; bottom, green mud. Two males having nine teeth on rostrum. Taken with one of the females of the preceding species.

Off Yokohama, in from 5 to 20 fathoms. Three males and three females.

On the 18th September 1874, near the Arrou Islands in the Arafura Sea, between Stations 190 to 191, a male specimen was taken associated with *Penæus velutinus*.

Rostrum horizontal on the dorsal surface, where it is armed with several small equidistant teeth. In the male they have a tendency to be fewer than in the female. In some specimens of the former I have counted as few as six (but two from Station 190 have nine), and in the latter the number is very constantly eight, and in addition there is one more distantly planted on the gastric region. The lower margin of the rostrum is free from denticulations, but closely fringed with ciliated hairs; in the male the lower margin is less curved in its ascent than in the female, and has consequently a narrower and sharper appearance. There is a small carina that traverses the median line to the posterior extremity of the carapace. It is lost on the first somite of the pleon, but reappears in the shape of a small tubercle near the centre of the second somite, after which it appears again on the third, whence it is continuous to the posterior extremity of the sixth and is there produced to a small tooth.

On the frontal margin of the carapace is a small orbital tooth and a tolerably strong antennal one, and between them a longitudinal depression that appears to be connected with the orbit; it carries a well-formed hepatic tooth, which, unfortunately, has been omitted by the lithographer in the figure.

The ophthalmi are ovate and moderately large. The first pair of antennæ has the peduncle longer than the rostrum, and supports two flagella equal to the peduncle in length; the outer and inferior is the larger and in both sexes tapers gradually to the extremity. The prosartema reaches to the extremity of the eye, but scarcely beyond it, and the stylocerite does not reach to beyond half the length of the ophthalmopod. The second pair of antennæ has the scaphocerite extending beyond the rostrum, but not quite as far as the extremity of the peduncle of the first pair, and the external distal tooth extends nearly as far as the distal extremity of the scaphocerite.

The first two pairs of pereiopoda carry on the basis a long and spiniform tooth. The third pair in the female carries the external passage of the oviduct, projecting on a small

tubercle, posterior to which, between the coxæ of the fourth and fifth pairs, lies the thelycum (fig. 1‴), which consists of two divisions, the anterior being an elevated cordiform plate and the posterior a circular prominence surrounding a central depression.

In the male the fifth pair of pereiopoda carries the foramen of the vas deferens on a prominence on the inner side of the base of the coxa, and the first pair of pleopoda supports a petasma (fig. 1″) that folds like a double-fluked anchor, the arms of which extend laterally and lie flat against the ventral surface of the pereion and its appendages. The second pair of pleopoda is two-branched; the inner branch supports at the base a button-like process. The succeeding pairs are only generic in character and become smaller in succession posteriorly. The posterior pair, which contributes to form the rhipidura, has no tooth projecting on the outer margin, but the external ridge terminates at the external distal extremity; a second ridge commencing near the centre of the basal joint traverses the plate diagonally, and meets the external margin at the same place as the obsolete diæresis. The inner plate is nearly as long as the outer, and is longitudinally traversed by two central ridges; one, commencing at the articulation, continues in a straight line to the apex; the other commences at the inner margin near the base, whence in a curved line it turns inwards and then continues parallel with the central ridge to the apex. The telson runs to a sharp point, the sides are depressed and fringed with hairs, amongst which is one small spine on each side, visible only on close observation through a hand-lens, whence it somewhat suddenly narrows. The dorsal surface is flattened, and traversed in the median line by a longitudinal groove.

Observations.—This species bears a close resemblance to *Penæus velutinus*, Dana. The two forms, moreover, are generally found associated in the same localities, and on casual observation might be mistaken for one another. Both are tomentose, carinated on the posterior somites of the pleon, have a number of teeth on the rostrum, and the ophthalmopoda resemble each other.

But in *Penæus velutinus* the flagella of the first pair of antennæ are very short, not being longer than the last two joints of the peduncle, while in *Penæus anchoralis* they are as long as the peduncle itself. There is no fissure between the supraorbital and the antennal tooth in *Penæus velutinus*, like that in *Penæus anchoralis*. In *Penæus velutinus* there is no fissure on the margin of the first somite of the pleon, but in *Penæus anchoralis* there is one that bisects it subequally. In *Penæus velutinus* the carina on the third somite of the pleon is double, or longitudinally grooved; in *Penæus anchoralis* it is entire. In *Penæus velutinus* the fourth and fifth somites are cleft at the posterior extremity, and the carina elevated in front of the cleft to a small tooth; in *Penæus anchoralis* the cleft is scarcely appreciable, and there is no tooth. The scaphocerite in *Penæus velutinus* is furrowed on the lower surface, and the diagonal ridges are not conspicuous, while in *Penæus anchoralis* the lower surface is polished, and the ridges are larger and conspicuous. In *Penæus velutinus* the first pair of pereiopoda has a long

tooth on the basis and another on the ischium, and there is one on the basis of the second pair, but in *Penæus anchoralis* there is one only on the basis of each pair of legs. The telson in *Penæus velutinus* is as long as the outer plates of the rhipidura, and is laterally armed with four movable spines and one rigid tooth, while in *Penæus anchoralis* it is one-fourth shorter, and is armed with three small spines of so little importance that they are only appreciable by a lens under certain aspects. In addition, the form of the petasma in the male, and of the thelycum in the female, together with the unusual presence of two long ventral teeth between the coxæ of the second pair of pereiopoda, go to make up the characters of two very distinct species of which the general external appearance is almost similar.

They appear not to be inhabitants of deep water, inasmuch as they have not been taken at a greater depth than 50 fathoms, and their range appears to be from Japan in the north to the northern shores of Australia in the south.

Penæus philippinensis, n. sp. (Pl. XXXV. figs. 2, 3).

Tomentose; no carina on the posterior half of the carapace. Rostrum horizontal, straight in the male, a little elevated in the female, armed with seven teeth that become smaller and further apart as they approach the extremity, and one very small tooth posterior to the rest and more remote, situated on the gastric region. Pleon laterally compressed and produced to a faint carina from the second to the sixth somite, where it culminates in a small point at the posterior extremity.

Ophthalmopod short, ophthalmus large, not quite half the length of the rostrum. Peduncle of the first pair of antennæ scarcely reaching to the extremity of the rostrum. Flagella short, slender, and rather longer than the last two joints of the peduncle. Stylocerite slender, sharp-pointed and curved upwards at the extremity, prosartema reaching a little beyond the extremity of the eye.

Second pair of antennæ long, slender, having the scaphocerite equal in length to the rostrum and subequal to the peduncle of the first pair of antennæ, and having the antero-external tooth parallel with the distal margin of its foliaceous plate. The pereiopoda are not very long, none reaching, when extended forwards, as far as the extremity of the rostrum, and the dactyli of the last two pairs are short. The first pair carries a tooth on the basisal and one on the ischial joint, but there is none on the second; a deep depression exists in the male between the coxæ of the two or three posterior pairs, in which the petasma, attached to the first pair of pleopoda, lies. The petasma (fig. 3″) is folded longitudinally in a columnar form, somewhat resembling the same organ in *Penæus velutinus*, but the shaft on the left side, being the longer, is folded over in a coil in front of that of the right. The second pair of pleopoda has the complementary button-shaped appendage consisting of a long, curved, tubular process

lying contiguous to the inner margin of the smaller and inner branch. All the other pairs are of merely generic value.

The posterior somite of the pleon is long, being nearly twice the length of the preceding one.

The telson is not so long as the inner plate of the rhipidura; it is sharp-pointed, dorsally grooved, and armed at the margins on each side near the distal extremity with three long spines and with one posterior, rigid, slender spine-like tooth.

In the female the peduncle of the first pair of antennæ does not reach quite as far as the extremity of the rostrum, and the scaphocerite attached to the second pair is also shorter.

The sexual tubercle attached to the coxa of the third pair of pereiopoda (fig. 2″) is longer than usual, projects obliquely backwards, and does not approach so near to its fellow as is generally the case in other species. The thelycum consists of two longitudinal plates united together in a straight line in the centre, and lobed on the outer sides, being held in position by clamp-like lateral processes, but which can best be understood by reference to the Plate (fig. 2″). In all other respects, except in the absence of the secondary sexual organs, the female resembles the male.

Habitat.—Station 192, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; off the Ki Islands, south of Papua; depth, 140 fathoms; bottom, blue mud. Two male specimens; trawled.

Station 201, October 26, 1874; lat. 7° 3′ N., long. 121° 48′ E.; off the Celebes Islands; depth, 82 fathoms; bottom, stones and gravel. Twenty-seven specimens; ten females, seventeen males; trawled.

Station 219, March 10, 1875; lat. 1° 54′ S., long. 146° 39′ 40″ E.; off the Admiralty Islands; depth, 150 fathoms; bottom, coral mud. Numerous specimens; associated with *Panulirus angulatus*. Eight males and two females; trawled.

Observations.—The animal is slender, and has the pleon long, the sixth somite being twice the length of the preceding one. In the male specimens the rostrum is straight, being in the same horizontal plane as the dorsal surface of the carapace, and not gradually elevated from the base as in *Penæus velutinus*.

In most of the adult female specimens the extremity of the rostrum is slightly elevated. The eyes are very similar to those of *Penæus velutinus*. The first pair of antennæ has the flagella slightly longer, and the stylocerite on the outer margin is united to the first joint for half its length and then curved upwards, and is scarcely as long as in *Penæus velutinus*, and the prosartema is more pointed. The synaphipod attached to the mandible is covered with a thick fur on the lower and external surfaces. In most respects the other parts resemble those described in *Penæus velutinus*, excepting that the posterior two pairs of pereiopoda, which in *Penæus philippinensis* have the dactylos shorter and less flattened than in *Penæus velutinus*, have a furrow

longitudinally traversing the propodos, which does not exist in *Penæus velutinus*. But the great distinction from other species exists in the form of the ventral surface of the posterior somites of the pereion in the female, and in that of the petasma attached to the first pair of pleopoda in the male. In the female, originating within the posterior margin of the ultimate somite of the pereion, are two flat plates, separated from each other by a median furrow; they proceed forwards as far as the anterior margin of the penultimate somite, and anteriorly are widened outwards. The third pair of pereiopoda carries the oviducts, each of which opens by a small foramen at the extremity of an elongated tubercle, that is directed obliquely backwards nearly to the anterior margin of the thelycum; and there exist no long and slender teeth between the coxæ of the second pair as in *Penæus velutinus*. The first pair of pleopoda in the female does not differ materially from that in *Penæus velutinus*, but in the male the petasma differs in having the extremity of the left side, which is the longer, and which projects forwards in *Penæus velutinus*, coiled up and doubled inwards in this species (fig. 3″). Consequently the following distinctions will be found to be means of ready diagnosis in determining *Penæus philippinensis* from *Penæus velutinus*, namely, the length and horizontal position of the rostrum; the furry character of the synaphipod of the mandibles; the arrangement of the petasma attached to the first pair of pleopoda in the males; the absence of the long, spine-like, ventral teeth between the second pair of pereiopoda in the females; the reduced depth of the carina on the dorsal surface of the last two somites of the pleon, and the shortness of the telson, which is armed with three articulated spines and a small fixed tooth on each side behind and above the posterior spine.

The above description is drawn from specimens which were taken amongst the Celebes Islands, and it applies to all the adult forms.

In the younger males, judging from a solitary half-grown specimen, the foliaceous ramus of the first pair of pleopoda is neither broad nor well developed, and is probably immature. The extremity of the vas deferens projects from the coxa of the posterior pair of pereiopoda, and when elongated falls into a groove on the posterior surface of the petasma, and is probably in this way directed and held in position during coition.

From the branchial chamber of one or two male specimens I took a large species of *Bopyrus*.

Penæus fissurus, n. sp. (Pl. XXXVI. fig. 1).

Rostrum reaching but little beyond the extremity of the first joint of the first pair of antennæ; dorsal margin furnished with six small teeth and one remotely posterior upon the gastric region, from which a small carina passes to the posterior margin of the carapace; inferior margin ciliated. Pleon compressed and carinated from the third somite. The posterior margin of the fourth, fifth, and sixth somites

terminating in a small tooth. Telson long and pointed, dorsally channelled, and laterally armed with a strong tooth and with some hairs on each side.

The ophthalmus is large, oblong, and reaches to nearly the extremity of the rostrum.

First pair of antennæ having the peduncle extending considerably beyond the rostrum. The flagella unequal; the longest being half the length of the peduncle, the shortest half its length.

Second pair of antennæ about once and a half as long as the animal, and the scaphocerite reaching beyond the extremity of the peduncle of the first pair.

The first pair of pereiopoda has a tooth on the infero-anterior angle of the basis, and another on the same position on the ischium; the second and third pairs are unarmed.

A linear fissure longitudinally traverses the carapace on each side, from the orbit to just within the posterior margin of the carapace, and a similar but shorter fissure vertically divides the branchial margin opposite the third pair of pereiopoda.

Length of female, 105 mm. (4·2 in.). Male, 85 mm. (3·4 in.).

Habitat.—Station 190, September 12, 1874; lat. 8° 56′ S., long. 136° 5′ E.; depth, 49 fathoms; bottom, green mud. One male; two females. Trawled.

Station 204A, November 2, 1874; lat. 12° 43′ N., long. 122° 9′ E.; off Tablas Island; depth, 100 fathoms; bottom, green mud.

Station 204B, November 2, 1874; lat. 12° 46′ N., long. 122° 10′ E.; off Tablas Island; depth, 115 fathoms; bottom, green mud. Two females. Trawled.

Station 209, January 22, 1875; lat. 10° 14′ N., long. 123° 54′ E.; off Zebu; depth, 95 to 100 fathoms; bottom, blue mud; bottom temperature, 71°. Ten specimens. Five males, five females. Trawled and dredged.

This form approximates closely to *Penæus monoceros*, Fabricius, the most apparent distinctions being that *Penæus monoceros* has nine teeth on the dorsal surface of the rostrum, whereas *Penæus fissurus* has six, and the telson has a strong tooth on each side, while *Penæus monoceros* has none.

I have utilised this peculiar fissure as a name to the species so that it may receive the attention of naturalists. I have also seen it in a species, allied in form to *Penæus affinis*, in the Museum of the Jardin des Plantes. I do not know its value, but am inclined to think that it is not of much specific importance, and may be caused by an approaching moult; of this, however, I have no experience to guide me, as in all forms that have been observed, excepting in the Brachyura, the carapace is thrown off entire.

The rostrum is about one-third the length of the carapace and horizontal; it is armed with six teeth, and one on the gastric region, from which the dorsal carina extends to the posterior margin of the carapace. The frontal margin is hollowed close to the base of the rostrum, on the outer side it projects and is produced to a small tooth, from near

the apex of which the frontal margin continues in advance until it again forms a hollow on the inner side of the antennal tooth, in which depression a fissure in the integument originates and continues in an almost direct line to near the posterior margin, where it abruptly terminates. Another tooth stands on the hepatic region, and another small one projects from the fronto-lateral angle of the carapace.

There is no carina on the dorsal surface of the first and second somites of the pleon, but one commences on the third, increases posteriorly, and terminates in a tooth at the extremity of the sixth somite. The telson is nearly as long as the inner branch of the rhipidura, and is dorsally grooved in front in a longitudinal direction, longitudinal and flattened posteriorly, where the sides project into a strong tooth, and the margins are fringed with long cilia.

The ophthalmopod is biarticulate; the first joint carries on the inner distal extremity a broad, flattened, anteriorly-directed tooth; the second supports the ophthalmus, which is somewhat pear-shaped, being narrow at the peduncle, flattened on the inner side, rounded externally and oblong longitudinally, and reaching nearly to the extremity of the rostrum.

The first pair of antennæ reaches to about twice the length of the rostrum and supports two slender, unequal flagella, the inner being shorter than the peduncle and the outer half its length. The prosartema is not so long as the ophthalmopod and is fringed with long cilia; the stylocerite is nearly as long.

The second pair of antennæ is nearly twice as long as the animal, its scaphocerite reaches beyond the peduncle of the first pair, and its rigid outer margin is continued to a small tooth that projects near the distal extremity of the scale.

The first pair of pereiopoda carries a sharp, strong tooth on the basisal and one on the ischial joint, but there is none on the second and third pairs.

The fourth and fifth pairs are more slender than the preceding chelate limbs, and terminate in somewhat long and rather compressed dactyli. The fifth does not possess the excavation in the frontal margin of the ischium which is seen in the near allies *Penæus incisipes* and *Penæus affinis*.

The specimens that were trawled at Station 209 differ from those from Station 204, although in the same immediate region among the Philippine Islands, in having the rostrum longer, being quite half the length of the carapace, and in having the flagella of the antennæ somewhat longer. At first I thought that the two were distinct varieties, but I believe they can only be considered rather as strongly developed specimens of the same species. Among the former are several specimens of the male in which the first pair of pleopoda carries a petasma that is longitudinally folded on itself, and the apex or distal extremity is doubled in complex folds, forming two heads too complicated to describe, and the second pair carries a large button-shaped process; all the others are of only generic value.

The first pair of pleopoda in the female has the inner branch reduced to a rudimentary condition. There was no male taken at Station 204.

The sixth pair, which forms the movable plates of the rhipidura, has the inner plate a little, and the outer plate much longer than the telson; the outer is obliquely and longitudinally traversed by a groove which continues to just within the outer extremity of the diæresis, on each side of which groove is a longitudinal ridge that, becoming confluent beyond it, traverses the outer margin of the plate and terminates in a well-developed but not large tooth that falls considerably short of the distal extremity, which is thickly fringed with ciliated hairs. The diæresis is rigid and situated near the middle of the plate. The inner branch is longitudinally traversed in the median line by a straight groove, its margins being elevated to a ridge, the inner of which, not shown in the figure, bifurcates not far from the base and abruptly turns away and joins the inner margin.

Penæus rectacutus, n. sp. (Pl. XXXVI. fig. 2).

Rostrum horizontal, straight, pointed, armed on the upper surface with twelve teeth which diminish in size anteriorly to a rudimentary condition, and one solitary distinct tooth standing over the gastric region. The lower margin of the rostrum is straight and slightly elevated anteriorly, the outer orbital tooth is prominent but not large, and so is the one on the hepatic region. The dorsal surface of the carapace behind the gastric region exhibits a tendency to become carinated, which disappears entirely on the pleon until the posterior division of the third somite is reached, where it increases to a distal carina which culminates in a sharp tooth at the posterior extremity of the sixth somite.

The eyes are large, and the first pair of antennæ has the peduncle of about the same length as the rostrum, and the flagella are equal to one another in length.

The telson in the typical specimen has two small articulating spines on each side, beyond which it has been broken off.

Length (female), 114 mm. (4·5 in.).

Habitat.—Station 173, July 24, 1874; lat. 19° 9′ 35″ S., long. 179° 41′ 50″ E.; off Matuku, Fiji Islands; depth, 315 fathoms; coral mud. Five females. Dredged.

Station 209, January 22, 1875; lat. 10° 14′ N., long. 123° 54′ E.; between Bohol and Zebu; depth, 95 fathoms; bottom, blue mud; bottom temperature, 71°·0. One female. Trawl and dredge both used.

This species comes near to *Penæus monoceros*, Fabricius, as described by Milne-Edwards, but differs in having the rostrum a little longer and the denticles on the upper margin rather more numerous, in having the flagella of the first pair of antennæ longer, and in the sides of the telson being armed with two or more spines.

In our solitary specimen, which is a female, the rostrum reaches as far as the extremity of the peduncle of the first pair of antennæ, and is styliform and armed on the upper side with twelve little teeth, the posterior of which are longer and placed nearer together, diverging and becoming smaller as they approach the anterior extremity of the rostrum, where they become almost rudimentary; posterior to these is one distant, solitary tooth, standing on the gastric region, behind which a slight compression is shown in the dorsal elevation of the median line of the carapace. The lower margin of the rostrum is smooth and fringed with long ciliated hairs. The frontal margin has no supraorbital tooth, and the outer antennal tooth, although well advanced, is small, as is also the tooth at the antero-inferior angle of the carapace.

The pleon commences to be carinated at the posterior dorsal extremity of the third somite, and rises into a small ridge on the three following; the posterior extremity of the fourth and fifth being slightly cleft in the median line; and the sixth, which is nearly twice the length of the fifth, terminates in a small tooth.

The ophthalmus is large, stands on a short bi-articulate peduncle and does not reach to the extremity of the rostrum.

The first pair of antennæ has the third or terminal joint cylindrical and longer than the second, and the flagella are as long as the peduncle. The prosartema is sharply pointed, the stylocerite is short and blunt, and the outer margin of the first joint is produced to an acute tooth.

The second pair of antennæ has the flagellum broken, but the scaphocerite is equal in length to the rostrum, and the tooth on the outer margin does not quite reach the extremity.

The pereiopoda are rather long, the third pair reaching to a little beyond the extremity of the rostrum. The first pair carries a spine-like tooth attached to the basisal and ischial joints; there is none on the second and third pairs.

The protuberance through which the oviduct projects is large and directed inwards, and the thelycum, which is divided, is posteriorly broad and anteriorly narrow, ending in a blunt point, and is studded with short hairs.

The pleopoda are of only generic value, possessing no specific feature except in the case of the posterior pair, which goes to form the lateral plates of the rhipidura; the outer plate is deeply grooved in the median line, the marginal ridge of which unites with one on the outer margin of the plate, and terminates in a tooth at the diæresis, about one-third distant from the extremity of the plate. The inner plate has a longitudinal groove in the median line with a strong ridge on each side, the inner, near the base, turning suddenly to the inner margin.

Our typical and only perfect specimen is a female, and was taken between Manila and Samboangan, associated with *Penæus fissurus*.

Several specimens were taken with the dredge off Matuku, one of the Fiji Islands, in a soft and damaged condition; the form of the thelycum in these corresponds with that

of the type, but differs from that of *Penæus serratus*, with which they were found associated. In these specimens the telson is armed with two teeth posterior to the two lateral spines, and therefore *Penæus rectacutus* may be only a variety.

Penæus serratus, Spence Bate (Pl. XXXVII. fig. 1).

Penæus serratus, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 182, 1881.

Rostrum slightly arched, armed with a series of small teeth, twelve or thirteen in number, between the base and the apex, and one distant on the gastric region; lower margin fringed with long, ciliated hairs, each of which stands on its own defined point of attachment. Posterior somite of the pleon more than twice the length of the penultimate. Telson nearly as long as the inner branch of the rhipidura, terminating in a styliform point, and armed on each side with a long and rigid tooth, and at some little distance anteriorly with two minute separate spines, the intervening space being fringed with hairs.

The ophthalmus is large, and the peduncle of the first pair of antennæ is rather longer than the rostrum. The flagella, in a young specimen, are about as long as their peduncle; they are damaged in the others. The prosartema is pointed, the stylocerite short, and the scaphocerite of the second pair reaches to the extremity of the rostrum.

Length of the largest female, 114 mm. (4·5 in.); of the largest male, 76 mm. (3 in.).

Habitat.—Station 173, July 24, 1874; lat. 19° 9′ 35″ S., long. 179° 41′ 50″ E.; off Matuku, Fiji Islands; depth, 315 fathoms; bottom, coral mud.

Station 184, August 29, 1874; lat. 12° 8′ S., long. 145° 10′ E.; Torres Strait; depth, 1400 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·0. One specimen, young.

Length, 26 min. (1 in.).

The surface of the animal is smooth and even polished. It is slender in general shape—a circumstance that is probably partly due to the length of the sixth or posterior somite of the pleon, which is rather more than twice the length of the fifth. The rostrum, instead of being horizontal, rises slightly from the base and is depressed at the apex, so as to give it a slightly arched appearance. The lower margin is without teeth, but fringed with hairs, each of which is extremely long and ciliated, stands upon its own little elevated point of attachment, and is generally of a dark colour. The upper or dorsal surface is serrate with small teeth, placed closely together towards the base, but distantly separated towards the apex; on the gastric region a solitary tooth stands apart from the rest, at the extremity of a carina, which disappears until the fourth somite of the pleon, where it reappears in the form of a small ridge. This ridge becomes larger on the fifth and sixth somites, having its posterior extremity cleft on the fourth and fifth, and produced to a small tooth on the sixth. The telson is not so long as the inner branch of the rhipidura, and terminates in sharp and styliform points (fig. 1z), it is broadly channelled

on the dorsal surface, the margins of which are produced on each side into a long, sharp tooth, and at some distance there are two minute spines standing in a fringe of small hairs.

The ophthalmopoda are tolerably large, and in the males reach nearly to the extremity of the rostrum. They stand on a short stalk.

The first pair of antennæ, in the male, has the peduncle longer than the rostrum, in some small specimens very much longer, a circumstance showing that the relative length of these parts is not so important as is generally supposed. The prosartema is sharp at the extremity, and the stylocerite is short and stunted, while the outer and anterior angle of the first joint is produced to a sharp-pointed tooth. The third joint is larger than the second, and cylindrical in form. The flagella of this pair are broken off in all the specimens excepting one; in this the outer branch is longer than the inner and also than the peduncle, and the antennæ are longer than the carapace.

The scaphocerite is about the same length as the rostrum, except in a small specimen where it is longer, but this appears to be due to the shortness of the rostrum rather than to the length of the appendage.

The pereiopoda are subequally robust, the third pair reaches as far as the extremity of the rostrum.

The pleopoda are of only generic value, except the posterior pair, which form the lateral plates of the rhipidura; the outer plate is channelled by a longitudinal groove that strikes the outer margin at the line of the diæresis and considerably within the distal extremity of the plate. The inner plate is longitudinally grooved, much as in other species.

On the ventral surface of the pereion in the female the thelycum is very small, and will be better understood by reference to the figure in the Plate (fig. 1‴ ♀) than from any verbal description.

The first pair of pleopoda carries a small and rudimentary appendage, which in the male is developed into a large and longitudinally folded petasma (fig. 1″ ♂), the lateral margins of which are turned backwards and the median portion forwards, while the extremity is furnished on each distal angle with an anteriorly-directed, sharp, slender process or tooth.

The second pair carries a double button-shaped tubercle at the base of the inner branch.

The branchiæ (fig. 1, *br*) in their ultimate structure resemble those of the type of the genus, and consist of a series of digital processes that divide into two branches and generally terminate in four processes.

The specimens referred to under *Penæus rectacutus* as having been taken off the Fiji Islands, were taken associated with this species. They were placed under *Penæus rectacutus* because the thelycum corresponds with that species rather than with the type of this.

Penæus tenellus, n. sp.

Animal slender and smooth. Rostrum slightly elevated above the dorsal surface, about one-half the length of the carapace, and armed with seven teeth anterior to the frontal margin, which is furnished with a rather large first antennal tooth, and a small one at the fronto-lateral angle. There is one also on the hepatic region. The rest of the animal is smooth, excepting on the dorsal surface, where there is a small carina that commences on the fourth somite and terminates in a small tooth at the extremity of the sixth.

The telson is short, tapering, free from armature, and dorsally channelled on the median line.

The ophthalmopoda are biarticulate, short, the ophthalmus large but not reaching to the extremity of the rostrum.

The first pair of antennæ has the peduncle much longer than the rostrum, and subequal in length to the scaphocerite of the second pair of antennæ, which carries a flagellum twice as long as the animal.

The other appendages, as far as have been examined, offer nothing very striking.

Length, 35 mm. (1·4 in.), female.

Habitat.—Station 235, May 17, 1875; lat. 34° 39′ N., long. 135° 14′ E.; Bay of Kobé, Japan; depth, 8 fathoms; bottom, mud. Dredged.

The body of the animal is slender, but not much laterally compressed, excepting the three posterior somites of the pleon. The carapace is but little more than one-fourth the length of the animal, and is dorsally compressed but not carinated; the anterior portion projects to a rostrum that is about half the length of the carapace, and is armed with seven small teeth, all in advance of the frontal margin, the largest being in the middle and the smaller at each extremity. The orbital notch is broad, and at the outer canthus projects into a large and well-defined tooth; there is none corresponding with the second pair of antennæ, but the fronto-lateral angle is produced to a small point. On the hepatic region is a small well-defined tooth, but there is none on the gastric region.

The three anterior somites of the pleon are dorsally smooth, but the fourth, fifth, and sixth are carinated and compressed, the posterior terminating in a small tooth.

The telson is about half the length of the lateral plates of the rhipidura, and gradually tapers to a point, and has no lateral armature, and is dorsally flattened and longitudinally grooved in the median line.

The peduncle of the ophthalmopod is short. The first joint has a small, round, flat, discoidal plate on its inner distal extremity, but the ophthalmus is large and reniform, reaching nearly to the extremity of the rostrum.

The first pair of antennæ carries a slender prosartema that reaches nearly to the

extremity of the ophthalmopod; on the outer side is a short stylocerite, and at the distal extremity of the first joint, which is subequal in length to the rostrum, is a short, sharp tooth; the second joint is nearly as long as the first, and furred with short hairs; the third is short and smooth, carrying at its extremity two flagella, of which the inner and lower is the more robust; they are subequal in length, nearly as long as the peduncle, and with it longer than the carapace.

The second pair of antennæ has the basal joint of the peduncle robust and the terminal slender, it carries a scaphocerite that is subequal in length to the peduncle of the first pair, and is very rigid on the outer surface, and terminates in a subapical tooth. The flagellum is slender, very flexible, and once and a half as long as the entire animal.

The mandible carries a synaphipod that has the first joint large and broad, the second narrow and short, and both roughly pilose.

The second pair of gnathopoda is slender, reaches as far as the distal extremity of the rostrum, and carries a basecphysis that extends as far as the distal extremity of the carpos.

The pereiopoda are slender, the third pair being the most slender, and longer than the preceding, and terminating in a slender chela. The fourth pair is more slender and slightly longer than the third, and terminates in a styliform dactylos that is nearly as long as the propodos. The fifth pair is lost.

The first pair of pleopoda is single-branched, the others are biramose. The sixth pair forms the lateral plates of the rhipidura, and the outer is nearly twice as long as the telson; it has a diæresis near the middle, and on the outer distal angle a small tooth.

The ventral surface of the pereion is smooth at the posterior extremity, continuing forwards to nearly the penultimate pair of pereiopoda, and is further advanced on each side than in the middle, from which point the stalk of a spade-shaped plate projects, and covers the ventral space between, and overlaps the coxæ of the fourth pair of pereiopoda.

Observation.—This species bears a close resemblance to the imperfect specimen described and figured by Dana, under the name of *Penæus tenuis*, taken from the stomach of a fish, caught in the Atlantic, off the coast of North Patagonia, excepting that instead of seven teeth on the rostrum, Dana's species has nine or more. "The beak is broken, and we cannot give the character of the under margin or extremity."[1] "Length one and a half inch."

Penæus gracilis, Dana.

Penæus gracilis, Dana, U.S. Explor. Exped. Crust., p. 606, pl. iv. fig. 7, *a*, *b*.

Slender; carapace about one-third the length of the pleon, rostrum dorsally armed with four or five small teeth, of which two are posterior to the frontal margin, and a third is on the gastric region. The lower margin of the rostrum is smooth. Anterior

[1] Dana, *tom. cit.*, p. 605, pl. xl. fig. 6.

five somites of the pleon subequal in length and dorsally smooth. The sixth equals in length the four preceding somites, is dorsally smooth and produced posteriorly to a small tooth, as is also the postero-inferior angle of the lateral margins.

Telson about two-thirds the length of the sixth somite.

The ophthalmopoda are short, long-ovate, and reach but little beyond the extremity of the rostrum.

First pair of antennæ having the peduncle subequal in length to the carapace. First joint nearly twice as long as the ophthalmopoda; second about two-thirds the length of the first, and the third about half the length of the second, supporting two flagella that are shorter than their peduncle. The longer branch has only five or six articuli, of which the basal is the longest and the terminal the shortest. The shorter branch has three or four articuli that are tolerably robust at the base, and three or four that suddenly become slender at the distal extremity.

The second pair of antennæ has the flagellum slender and about as long as the carapace, and carries a scaphocerite that equals in length the peduncle of the first pair.

The anterior three pairs of pereiopoda gradually lengthen posteriorly.

Fig. 47.—*Penæus gracilis*, Dana.

The fifth or posterior pair is slender.

The pleopoda are all single-branched; the first pair is straight, rigid, and carries in the median line of the ventral surface of the somite a protuberance that is furnished with three or four long hairs. The second pair is more flexible and has a similar but narrower protuberance at the base crowned with long hairs. The succeeding pairs are long, flexible, gradually lessening posteriorly, and are furnished in the median line at their base with a protuberance, produced to a sharp tooth, which becomes gradually less important posteriorly. The terminal pair, which goes to form the outer plates of the rhipidura, are broad, foliaceous and as long as the telson.

Length, 10 mm. Dana's specimen is given as 8 or 9 lines, or about double the length of the Challenger specimens.

Habitat.—The New Hebrides, and Port Jackson, Australia, are the places at which specimens corresponding with this species were obtained by the Challenger.

Dana's specimen was taken in the "Sooloo Sea, twenty-five miles east of Penay. Collected Jan. 27, 1842. Some seaweed was seen floating by during the day."

Dana says, "Penult. abdominal segment as long as two preceding, and having a few minute spines on the back of it."

There are no small spines on the dorsal surface of the sixth somite of the pleon in our specimen; but they might have been rubbed off. Undoubtedly Dana's specimen, although twice the size of those in the Challenger collection, is immature.

There is no evidence of sexual character such as is visible externally in mature forms; all the pleopoda are single-branched, a circumstance that is not comformable with the condition of a mature specimen of the genus *Penæus*, but is consistent with that of *Sicyonia*. In *Haliporus* the two branches are present but in a very unequal condition.

It must therefore be left for future research to determine the relation of *Penæus gracilis* to the adult stage.

Penæopsis, A. Milne-Edwards.

Penæopsis, A. Milne-Edwards, MS.
,, Sp. B., Ann. and Mag. Nat. Hist. ser. 5, vol. viii. p. 182, 1881.

Like *Penæus*, but with the flagella of the first pair of antennæ longer than the carapace.

There is no species of this genus in the Challenger collection.

This genus is very closely allied to Milne-Edwards' second division of *Penæus*, or those Peneids in which the flagella of the first pair of antennæ are longer than the carapace.

Penæus tenellus approaches nearer to it than any other in the Challenger collection, but the flagella are not longer, if even quite as long, as their peduncle, although together they are longer than the carapace.

Philonicus,[1] n. gen.

Carapace armed with four teeth on each side, namely, the first antennal tooth on the frontal margin, one behind it, one behind the second antenna, and one on the hepatic region, and produced anteriorly to a sharp-pointed rostrum that is laterally compressed and armed on the upper surface with small teeth.

The ophthalmopoda are biarticulate, shorter than the rostrum, and support an ophthalmus of moderate proportions.

The first pair of antennæ has a prosartema and stylocerite attached to the first joint, and terminating in two extremely long and subequally sized flagella, the upper of which is very slender, the lower very broad, but not grooved on the upper surface to

[1] φιλονείκος, a rival.

receive the smaller one as in *Solenocera*, Lucas. Both flagella exceed in length that of the carapace.

The second pair of antennæ is furnished with a large scaphocerite that generally equals the length of the peduncle of the first pair, and terminates in a slender flagellum of great length.

The mandibles have a two-jointed, long, broad and foliaceous synaphipod; of which the second joint is narrow, but not longer than the first, and reaches as far forwards as the distal extremity of the peduncle of the second antenna.

The oral appendages do not differ much from those of *Penæus*.

The first pair of gnathopoda carries a basecphysis that reaches to the distal extremity of the meros, and the coxal joint supports a mastigobranchia that is pedunculated and supports a branchial plume at its base.

The second pair of gnathopoda is long, pediform, and carries a small basecphysis and a mastigobranchia that is slightly forked at its distal extremity, but without a branchial plume.

The anterior three pairs of pereiopoda are chelate but neither stout nor very long. The posterior two pairs are long and slender, the ultimate being about two-thirds the length of the entire animal. Each pair carries a small basecphysis diminishing to a rudimentary condition posteriorly. The mastigobranchiæ are all long and pedunculated, but carry no branchial plume.

The entire series of the branchial apparatus may be tabulated as follows :—

Pleurobranchiæ, . . .	...	1	1	1	1	1	1
Arthrobranchiæ, . . .	1	2	2	2	2	2	...
Podobranchiæ, . . .	1	...	...	...	...	...	...
Mastigobranchiæ, . . .	1	1	1	1	1	1	...
	h	i	k	l	m	n	o

The male carries a large petasma attached to the basal joint of the first pair of pleopoda. The rhipidura is long and narrow, the outer branch showing traces of an obsolete diæresis.

The telson is narrow and slender.

This genus resembles *Penæus* in the character of the ophthalmopoda, which are biarticulate and supported on a free and exposed somite, but *Penæus* may readily be identified from it—

1. By the postantennal teeth on the frontal walls of the carapace.

2. By the length of the antennæ, the flagellum of the second pair being three times the length of the animal, or more.

3. By there being two arthrobranchial plumes attached to the penultimate pair of pereiopoda, and by the presence of a podobranchial plume attached to the mastigobranchial plate of the first pair of gnathopoda. The presence of which is an essential

distinction, and brings this genus in its branchial arrangement near to *Spongicola* and *Stenopus*, which it also approaches in the absence of the small basisal branch of the second pair of gnathopoda, which is rudimentary in these genera.

The general resemblance of some species to each other is very close, while others are easily distinguishable.

This genus very much resembles *Solenocera*, Lucas, from which in external structure it differs in having the flagella of the first pair of antennæ cylindrical, instead of one being grooved to receive the other.

I have not had an opportunity of examining the branchial arrangement of any species of *Solenocera*, and therefore cannot compare it with that genus.

It may from the description be mistaken for *Penæopsis*, A. Milne-Edwards, from which it can readily be distinguished by the form of the carapace, by the presence of post-orbital and postantennal teeth on it, and by the length of the peduncle of the first pair of antennæ.

It differs from the typical *Penæus* in having two arthrobranchiæ attached to the membranous articulation of the penultimate pair of pereiopoda, and in all the mastigobranchiæ being remarkable for a knee-like bend, by which the basal portion lies at right angles to the terminal half, which is placed between and separates the branchial plumes, and is liable to vary in form in different species.

Geographical Distribution.—Species of this genus have been found in the Sea of Banda, off the Kermadec Islands, among the Celebes Islands, off the Ki Islands, and in the Arafura Sea.

Penæus siphonoceros, Philippi and Heller, is undoubtedly synonymous with *Penæus membranaceus* of Milne-Edwards, and belongs to this genus, but not with *Penæus membranaceus* of Risso, from which it differs in the flagella of the first pair of antennæ not being distally truncated, nor in having the upper ramus longitudinally enclosed within a groove in the lower.

Penæus crassicornis, Milne-Edwards, also belongs to this genus, and is recorded by him as inhabiting the coasts of India. Sir Walter Elliot, S.I., F.R.S., procured numerous specimens at Waltair on the coast of Madras.

Philonicus mülleri, n. sp. (Pl. XXXIX.).

Carapace dorsally furnished with a small carina that commences at the posterior margin and continues anteriorly to the rostrum, which is armed on the upper margin with eight teeth in the female and with nine or ten in the male; the lower margin is smooth, slightly curving upwards to the extremity, and fringed with a row of hairs. The anterior margin of the carapace has an orbital and a first-antennal tooth, behind which are a postantennal and a hepatic tooth.

The pleon is dorsally carinated from the third somite to the extremity of the sixth, which is posteriorly produced to a sharp tooth; and the telson is dorsally grooved in the median line, and armed on each side with one strong tooth and a fringe of hairs.

The first pair of antennæ is nearly as long as the entire animal. The second pair is about four times as long; they are respectively shorter in the male than in the female.

Length—male, 76 mm. (3 in.); female, 152 mm. (6 in.).

Habitat.—Station 321, February 25, 1876; lat. 35° 2′ S., long. 55° 15′ W.; off Monte Video; depth, 13 fathoms; bottom, mud. Thirty specimens. Five males and twenty-five females. Trawled.

The rostrum, measured from the frontal margin of the orbit to the apex, is less than half the length of the carapace; it is produced horizontally and slightly crested over the orbit. It is armed with eight teeth in the largest female specimen, the posterior of which is situated slightly anterior to the cervical furrow, and they are continued, with a little tuft of cilia between each, to within a short distance of the apex, the largest teeth being over the orbit. The under margin is smooth, curved slightly upwards to the extremity, terminates in a point in the plane of the upper margin, and is fringed with hairs. The pleon is smooth except for a dorsal carina, which is slightly indicated on the first three somites, but is more conspicuous on the posterior three somites. The first somite laterally overlaps the posterior margin of the carapace, and posteriorly overlaps the anterior margin of the second; the second posteriorly overlaps the anterior margin of the third, and the same relation occurs in all the succeeding somites.

The ophthalmopod is large and biarticulate; the ophthalmus is oval and wider than its stalk.

The first pair of antennæ has the first joint of the peduncle armed on the outer side with a sharp-pointed stylocerite, and furnished on the inner side with a thickly ciliated prosartema that reaches to the extremity of the rostrum, between which and the stylocerite the eye, when at rest, is lodged. The second and the third joints are short and terminate in two subequal flagella, of which the upper is rather the longer.

The second pair of antennæ carries a broad scaphocerite that reaches considerably beyond the extremity of the rostrum, and even beyond the distal extremity of the third joint of the peduncle of the first pair, and terminates in a long and slender flagellum, which in one, the largest female specimen, was about four times the length of the animal. The mandible carries a large, ovate, foliaceous synaphipod, the first joint of which is broader than the second, which tapers to a point, and the entire surface is furred with short hairs. The psalisiform margin is blunt, smooth, and connected with the molar tubercle, which is smooth and strong.

The first pair of gnathopoda is short, subpediform, six-jointed, with the two ultimate

joints reflexed; the basecphysis is rudimentary, the coxa carrying a pedunculated mastigobranchia, to the base of which, near the joint, is attached a well-developed podobranchial plume.

The second pair is long, pediform, seven-jointed, and thickly pilose. The basecphysis is slender, small, and almost rudimentary. The coxa carries a pedunculated mastigobranchia without any branchial plume, but two arthrobranchial plumes are attached to the membranous articulation between the coxa and the pleura.

The first pair of pereiopoda is shorter than the second gnathopod, chelate, having the carpos but little longer than the propodos, measuring from the tips of the pollex to the carpal joint; the ischium and basis are each armed with a strong tooth on the anterior distal angle, and a tubercle tufted with hairs projects on the inner side of the coxa; the basecphysis is slender and as long as the ischium. The coxa carries a mastigobranchia without a plume attached. The second pair of pereiopoda is longer than the first, the carpos being twice the length of the propodos, and the basisal joint is armed with a strong tooth; the basecphysis is shorter than the meros and the mastigobranchia is without a plume. The third pair of pereiopoda is much longer than the second, and nearly twice as long as the first, the carpos being slender and four times the length of the propodos. There is a small tooth on the basisal joint and the basecphysis is rudimentary; the two following pairs are long, slender, and terminate in a simple styliform dactylos, the terminal pair being much longer and more slender, and having the propodos twice the length of the carpos and distally fringed with long hairs; both of these carry a short and almost rudimentary basecphysis, but only the former carries a mastigobranchia, the rigid peduncle of which is long and the foliaceous plate short, and the last somite carries only a pleurobranchial plume.

The pleopoda are moderately long and biramose, except the first pair, which has the inner branch reduced to a rudimentary condition (fig. 1″) in the female, and developed to a large and longitudinally corrugated petasma in the male (fig. 2″).

The telson terminates in a sharp point, flanked on each side by a sharp but strong tooth, anterior to which is a row of hairs.

Judging from the numerous specimens in the collection, thirty of which were taken at one station associated with *Artemesia longinaris*, the males differ from the females in being one half shorter.

Philonicus lucasii, Spence Bate (Pl. XLII. fig. 4).

Solenocera Lucasii, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 185, 1881.

Rostrum short, dorsally crested and laterally compressed, armed with seven teeth on the upper margin; the lower margin smooth. Pleon compressed and carinated from the third somite, the carina terminating in a small tooth at the posterior extremity of the

sixth. Telson half the length of the rhipidura, truncated between two prominent teeth; dorsal surface depressed.

The ophthalmopod does not reach to the extremity of the rostrum. The ophthalmus is orbicular. The first pair of antennæ has the first joint a little longer than the ophthalmopod, and carries on the inner side a prosartema that is as long as the joint, and on the outer side a stylocerite that is half the length, and a strong tooth at the outer distal angle. The second joint is nearly as long as the first, but the third is shorter and terminates in two subequally long, but unequally stout flagella, the length of which is rather more than that of the carapace. The second pair of antennæ carries a scaphocerite that reaches beyond the extremity of the peduncle of the first pair, bearing a tooth near the apex, and terminates in a slender flagellum that is about three times the length of the entire animal. The pereiopoda generally are short, except the posterior pair, which is long. The pleopoda are not remarkable for their length, and, excepting the first, are biramose. The posterior pair, which forms part of the rhipidura, has the inner branch ovate and the outer with its apex at the outer margin, where it terminates in a small tooth.

Length (female), 100 mm. (4 in.).

Habitat.—Station 192, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; off the Ki Islands, south of Papua; depth, 140 fathoms; bottom, blue mud. One specimen was trawled; female.

The rostrum is short and horizontal, with the under margin curved upwards at the apex; upper margin armed with seven subequidistant teeth, the spaces between them gradually increasing posteriorly, the last tooth standing behind the gastric region. The frontal margin is armed with an antennal tooth and one immediately behind it. There is also one on the hepatic region and one submarginal in advance of it below.

The pleon is compressed from the third somite posteriorly, and is dorsally furnished with a distinct and continuous carina from the third to the posterior extremity of the sixth somite, where it terminates in a small tooth.

The telson is half the length of the outer ramus of the rhipidura, and is dorsally grooved. It is terminally truncated and armed on each side with a long slender tooth.

The ophthalmopod is biarticulate, shorter than the rostrum, and terminates in an orbicular ophthalmus; the somite that supports it is exposed and movable.

The first pair of antennæ has the first joint as long as the rostrum, armed on the outer side with a short stylocerite, and at the distal angle with a long and slender tooth, and bearing on the inner side a prosartema copiously fringed with hairs; the second joint is nearly as long as the first, and the third is short and cylindrical, and supports two flagella, one more slender than the other and both longer than the carapace. The lower and more robust branch is longitudinally compressed, but not excavate as in *Solenocera*, in which the more slender flagellum when at rest lies imbedded in a groove in the larger.

The second pair of antennæ has a slightly tapering scaphocerite that reaches a little beyond the extremity of the peduncle of the first pair, and a flagellum that is twice the length of the animal.

The mandible carries a two-jointed synaphipod, the second joint is narrower than the first and reaches as far as the extremity of the peduncle of the second pair of antennæ.

The first pair of pereiopoda is armed with two teeth, one on the inferior margin of the basis and another on the antero-inferior margin of the ischium. All the appendages of the pereion are furnished with a basecphysis that decreases gradually to the posterior pair of pereiopoda, where it is very reduced in size.

The first pair of pleopoda in the female carries a rudimentary membranous branch on the inner margin, near the distal extremity of the basisal joint. The succeeding four pairs are subequally biramose. The sixth pair has the outer branch longer than the inner, and is armed with a sharp tooth on the outer side at the extremity.

Only a single specimen of this species, and that a female, was taken, and it differs from all the other species in having the basisal branch attached to the several legs of the pereion, although small, yet much more important than the rudimentary ones which they possess.

Philonicus pectinatus, n. sp. (Pl. XXXVIII.).

Rostrum short, lanceolate, not reaching to the extremity of the ophthalmopod; dorsal margin armed with nine teeth, of which the posterior is slightly separated from the others and implanted on the gastric region a little in advance of the cervical furrow. Posterior dorsal surface of the carapace compressed but not carinated. Pleon carinated from the fourth somite to the sixth, where it terminates in a small tooth.

Telson dorsally longitudinally grooved, tapers to a point, and is distally armed on each side with a strong tooth; outer plates of the rhipidura nearly twice as long as the telson.

Ophthalmopoda with the ophthalmi reniform. First pair of antennæ having the prosartema shorter than, and the stylocerite as long as the ophthalmopod. Second pair of antennæ having the scaphocerite longer than the peduncle of the first pair of antennæ, and narrowing to the distal extremity, which is rounded and carries a tooth on the outer angle.

All the other parts of the specimen are much broken except the pleopoda, the first pair of which is furnished with a petasma (*pp*) that carries a series of curved teeth on each side like a comb, from which the specific name is derived.

Length (male), 38 mm. (1·5 in.).

Habitat.—Station 188, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; Arafura Sea, south of Papua; depth, 28 fathoms; bottom, green mud. One specimen; male.

There is only one specimen of this species and that is imperfect, but in its general aspect it appears to belong to this genus, and carries a post-antennal as well as a hepatic tooth, but the broken condition of the first pair of antennæ precludes me from determining the exact relationship.

The form of the petasma is very distinct from that of any other species known to me, either of this genus or *Penæus*, and one that will readily be recognised from its series of curved, comb-like teeth.

The smaller rami of the branchiæ (*br''*) are short, laterally compressed, dichotomous and obliquely attached to the larger branch.

The mastigobranchial plates (*mb*) are broad, forked, and supported on a cylindrical stalk that has a lateral lobular prominence near the coxal articulation. The stalk is supported by a series of globular deposits of lime crystals.

The ultimate structure of the branchial plumes approximates to that in *Philonicus mülleri*, and consists of a series of compressed branches that terminate in flattened lobes, and of others broader and more foliaceous that terminate in papilliform processes.

The flagella of both pairs of antennæ, the second pair of gnathopoda, and all the pereiopoda are broken off close to their origin. The first pair of pleopoda, with its comb-like, fringed petasma, as well as the four succeeding pairs and the rhipidura, are preserved. The rostrum is broken but not detached.

Artemesia, n. gen.

Rostrum long, slender, and pointed, armed with a few teeth on the dorsal crest; body compressed, with a tendency to form a carina, more especially on the dorsal surfae of the pleon.

Ophthalmopoda biarticulate and ophthalmi ovate.

First pair of antennæ having a stylocerite and prosartema attached to the first joint of the peduncle, and two subequal flagella that are as long as the carapace.

Second pair having a scaphocerite and a long and slender flagellum.

Mandibles furnished with a two-jointed, broad, foliaceous synaphipod.

First pair of gnathopoda short, six-jointed and subpediform, the two distal joints being reflexed against the inner margin of the ischium and meros. The basis carries no ecphysis and the coxa supports a mastigobranchia with a podobranchial plume.

Second pair of gnathopoda pediform, seven-jointed and straight. The basis carries a long and slender ecphysis, but there is no mastigobranchia nor podobranchia, but two arthrobranchial plumes are attached to the membranous articulation.

First three pairs of pereiopoda chelate, slender, and each carries a small basecphysis and a pedunculated and forked mastigobranchia, but no podobranchia; the last two pairs are slender and simple, the posterior being longer and more slender than the pre-

ceding, and neither of these carries a basecphysis or mastigobranchia, and the posterior is without any branchial plume at all.

The branchiæ somewhat resemble in structure those of *Penæus*, but the dendritic branches appear to be more simple.

The following table shows their general arrangement :—

Pleurobranchiæ,	.	.	.	1	1	1	1	1	1	...
Arthrobranchiæ,	.	.	.	1	2	2	2	2	2	...
Podobranchiæ,	.	.	.	1	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	1	...	1	1	1	...	...
				h	i	k	l	m	n	o

The fourth pair of pereiopoda has two well-developed plumes, but one is pleurobranchial, interstitial between the fifth and sixth somites, and in one or more instance I have observed a rudimentary ecphysis attached to the basisal joint.

This genus bears some external resemblance to *Aristeus*, but differs in having two long flagella to the first pair of antennæ, in the form of the synaphipod and mastigobranchiæ, in the number of the branchiæ, in having no podobranchia except the one attached to the first pair of gnathopoda, and in the ultimate structure of the branchiæ.

In some of these points it corresponds with *Philonicus*.

Geographical Distribution.—As yet we only know one species of this genus, which was taken off the east coast of South America.

Artemesia longinaris, n. sp. (Pl. XL.).

Carapace dorsally smooth and produced anteriorly to a horizontal rostrum that is half the length of the animal, measured from the orbit to the posterior extremity of the telson. Rostrum crested over the base and armed there with nine or ten teeth, from which to the apex it is smooth both above and below. The pleon is smooth to the fourth somite, which is dorsally angulate. The fifth and sixth somites are slightly carinated, the carina on each being produced posteriorly to a small tooth.

The ophthalmopod reaches nearly to the extremity of the serrate crest, and the ophthalmus is ovate.

The first antennæ carries a prosartema that does not reach to the extremity of the ophthalmopod, and a stylocerite that is short and almost rudimentary; the peduncle reaches to about half the length of the antennæ, supporting two flagella that are twice the length of the rostrum.

The second pair of antennæ carries a scaphocerite that reaches as far as the distal extremity of the peduncle of the first pair, and a flagellum that is once and a half as long as the animal.

The pereiopoda are slender and not very long.

The outer plates of the rhipidura are longer than the telson, which is slender, tapering to a sharp terminal point, dorsally grooved, and armed on each side with four teeth, of which the posterior is the largest.

Length, male, 70 mm. (2·75 in.); female, 76 mm. (3 in.).

Habitat.—Station 321, February 25, 1876; lat. 35° 2′ S., long. 55° 15′ W.; off Monte Video; depth, 13 fathoms; bottom, mud.

Thirty-nine specimens; twelve of which were males and the rest females; were taken with the trawl, associated with *Philonicus mülleri*.

Station 113A, September 2, 1873; lat. 3° 47′ S., long. 32° 24′ 30″ W.; off Fernando Noronha, South America; depth 7 to 25 fathoms; bottom, volcanic sand and gravel. Only a doubtful fragment of a pleon, which may belong to this species, was here taken.

This species approaches *Aristeus*, but it is separated from it by the character of the antennæ, the structure and number of the branchial plumes, and also by the form of the mastigobranchial plates.

The rostrum is long, slender, and horizontal, it is slightly waved, and armed at the base above the orbit with from nine to twelve closely-packed teeth, forming an elevated crest, and further back on the gastric region is one small tooth, from which point to the posterior margin the carapace is smooth, with a slightly elevated line indicating a suppressed carina.

The pleon is smooth from the first to the fourth somite, where the suppressed carina reappears and increases to a decided degree on the fifth and sixth somites, on each of which it is produced posteriorly to a small tooth.

The ophthalmopod is biarticulate, as in the genus *Penæus*, and the ophthalmus is ovate.

The first pair of antennæ carries a short and stout stylocerite, and a prosartema on the inner side that does not reach to the extremity of the ophthalmopod. The peduncle reaches to half the length of the rostrum, and supports two long, slender, subequal flagella.

The second pair of antennæ has the scaphocerite a little shorter than the peduncle of the first pair, and a flagellum that is about once and a half as long as the animal.

The mandible (*d*) carries a broad, foliaceous, two-jointed synaphipod, of which the terminal joint tapers to a blunt point. The molar process is continuous with the psalistoma, which is produced anteriorly to a blunt tooth.

The third pair of siagnopoda (*g*) is three-branched. The first branch is squamiform and biarticulate, the inner margin being thickly fringed with cilia. The second represents the basecphysis, and bifurcates into two equally important divisions, of which one is biarticulate and the other squamous; at or near the base of the latter a foliaceous mastigobranchial plate originates.

The first pair of gnathopoda (*h*) is subpediform, having the three distal joints reflexed.

The basis does not carry a branch, or ecphysis; but the coxa supports a short mastigobranchia that is broad for a short distance from the base, and then suddenly narrows to a slender lash. At the base, near the articulation, is a well-developed podobranchial plume.

The second pair of gnathopoda (*i*) is pediform and seven-jointed. The basisal joint carries a long and slender ecphysis, and reaches nearly to the extremity of the sixth joint or propodos. There is no mastigobranchia attached to the coxa, but two arthrobranchiæ arise from the membranous articulation.

The first pair of pereiopoda is short, slender, and chelate, and carries a pedunculated, forked mastigobranchia without any podobranchial plume. The second and third pairs increase respectively in length, a circumstance that is chiefly due to the increased length of the carpos. They each carry a pedunculated and forked mastigobranchia similar to that of the first pair. The fourth and fifth pairs are long, slender, and terminate in a styliform dactylos, the posterior pair being much the longer of the two. Both of these are without either mastigobranchia or podobranchial plume; whereas the penultimate has two arthrobranchiæ, one of which, the anterior, is in a rudimentary condition. The general arrangement may best be understood by the table given under the description of the genus.

The ventral surface of the female, in all the specimens in the collection, shows the third pair of pereiopoda with a protuberance directed obliquely backwards, on the inner side of which the oviducts open and come into contact with each other in the median line: behind these is a deep depression, which is chiefly caused by an elevated process that supports the coxal articulation of the penultimate pair of pereiopoda. Posterior to this, approaching each other and slightly raised anteriorly in the median line, and posteriorly diverging outwards, are two long, slightly curved protuberances, the posterior extremities of which correspond with the articulation of the ultimate pair of pereiopoda.

In the male the anterior pair of pleopoda carries a petasma that is longitudinally folded into a cylindrical form, with the posterior surface open; the terminal extremity is lobed and supplied with four hook-like processes, two on each side. In the female this pair of pleopoda has only one branch, and a rudimentary process attached to the inner side of the peduncle. In the male the second pair has two unequal branches, and at the base of the inner or smaller is a small button-shaped process. The succeeding pleopoda correspond in both sexes, and gradually diminish in size. The posterior pair, that forms the lateral plates of the rhipidura, are long and narrow, both reaching beyond the extremity of the telson. The diæresis of the outer branch is reduced to an obsolete condition, being represented only by the muscular attachments which are situated near the body of the animal, and the small tooth on the outer margin which generally corresponds with its outer limit.

Haliporus,[1] Spence Bate.

Haliporus, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 185, September 1881.

Carapace submembranous, dorsal surface carinated, anteriorly produced to a rostrum. Frontal margin armed with an anteriorly projecting point or flattened tooth, corresponding with the outer side of the first pair of antennæ, and a second in a line behind it, with another tooth projecting outwards and forwards, corresponding with the outer side of the second pair of antennæ, and a fourth tooth on the inner side corresponding to the anterior portion of the hepatic region. The cervical suture is strongly defined upon the dorsal surface.

The pleon is laterally compressed, and the telson is long, slender, and laterally compressed.

The ophthalmopod is single-jointed and supports a small tubercle on the inner margin.

The first pair of antennæ carries only a short prosartema, and the stylocerite is short and stout. The peduncle is long, and so are the flagella, which in all probability are cylindrical as in other species, but are broken off in this the type-specimen.

The second pair of antennæ carries a long and narrow scaphocerite and a long and slender flagellum.

The mandibles carry a long two-jointed synaphipod; the first joint is ovate and reaches as far as the frontal margin, the second is narrow and reaches as far forwards as the extremity of the peduncle of the second pair of antennæ.

The first pair of gnathopoda is subpediform and carries a short basecphysis.

The second pair is long and pediform, and carries only the rudiment of a basecphysis.

The pereiopoda are long and devoid of a basecphysis.

The branchiæ consist of rather small and delicate plumes, and may be tabulated as follows:—

Pleurobranchiæ, . . .	...	1	1	1	1	1	1
Arthrobranchiæ, . . .	2	2	2	2	2	2	...
Podobranchiæ, . . .	1	r	r	...	...	...	...
Mastigobranchiæ, . . .	1	1	1	1	1	1	...
	h	i	k	l	m	n	o

In general appearance the species of this genus are more slender and membranous than in either *Solenocera* or *Philonicus*, and the appendages are longer.

The arrangement of the branchiæ is very nearly the same as in *Philonicus* but the mastigobranchial plates are much larger and more leaf-like, and extend farther between the plumes; one or two of the anterior plates carry a rudimentary podobranchial plume. The flagella of the first pair of antennæ are both cylindrical, there being no groove in

[1] From ἁλιπόρος, going through the sea.

which the smaller branch lodges. Externally this genus closely resembles *Philonicus*, from which, however, it may be readily distinguished by having a small tooth on the margin of the carapace corresponding to the outer side of the second pair of antennæ, and a small tubercle on the inner side of the ophthalmopod; by the ophthalmopod being single-jointed; by the length of the second pair of gnathopoda and of the last two pairs of pereiopoda; by the absence of a basecphysis, however rudimentary, on any of the appendages of the pereion posterior to the gnathopoda, and by the presence of rudimentary podobranchial plumes on the mastigobranchial plate of the second pair of gnathopoda and the first pair of pereiopoda.

Geographical Distribution.—The range of this genus is known only from the habitats of a few species; one from the Mid-Atlantic, and the others from the Mid-Pacific and the Polynesian Seas, and all from extremely deep water.

Haliporus equalis, n. sp. (Pl. XLI. fig. 1).

Rostrum in the male slightly elevated from the base, horizontal in the female, smooth below, fringed with long hairs, armed on the upper surface with nine teeth, six sharp, equally distant, and two on the gastric region. Both hepatic and antennal regions are furnished with four teeth; the second tooth, corresponding to the antenna, is situate behind the margin. Pleon smooth, laterally compressed. Last two somites dorsally carinated, the posterior terminating in a small but distinct tooth. Telson shorter than the inner branch of the rhipidura.

Ophthalmopod short, the ophthalmus orbicular and much larger than the diameter of the stalk.

The first pair of antennæ has a prosartema that is shorter than the ophthalmopod, and a stylocerite that extends beyond the outer angle of the first joint. The flagella are long and slender, equal in length to the entire animal.

The second carries a scaphocerite that extends beyond the extremity of the distal joint of the peduncle of the first pair, and terminates in a flagellum that is about twice the length of the animal.

The anterior three pairs of pereiopoda are rather short; the posterior two are very long and slender.

Length, of both male and female, about 63 mm. (2·5 in.).

Habitat.—Station 200, October 23, 1874; lat. 6° 47′ N., long. 122° 28′ E.; between the Philippine Islands and Borneo; depth, 250 fathoms; bottom, green mud. Seven specimens; females.

Observation.—This species very closely resembles *Penæus crassicornis*, Milne-Edwards, but it may readily be distinguished by the eye being larger and the peduncle

shorter, by the small tooth corresponding with the outer limit of the second pair of antennæ being situated behind the frontal margin of the carapace, but most decidedly by the different formation of the ventral portion of the pereion. In the female (fig. 1‴ ♀) the calcified tubercles that carry the oviducts are large and hirsute, and a transverse, lunate, nearly vertical plate lies behind them; posterior to this the processes of the coxæ of the fourth pair of legs project nearly to the median line; behind which is a broad shield-like thelycum, and then comes a transverse bar that defines the posterior extremity of the pereion.

In the male there is a heart-shaped process in the median line between the fourth pair of legs (fig. 1″ ♂), then a transverse bar supported by a nodular process in the median line, and posterior to this the enlarged coxæ of the fifth pair of pereiopoda, that support the vas deferens, nearly meet in the median line. The petasma is long, narrow when folded, and hooked to its fellow at the base, is nodulated, and furnished with small hairs at the extremity.

The branchiæ are of generic value, but the mastigobranchial plates are long, narrow, semi-forked at the extremity, and fringed with hairs.

Haliporus obliquirostris, Spence Bate (Pl. XLI. fig. 2).

Haliporus obliquirostris, Sp. B., *loc. cit.*

Rostrum elevated obliquely from the orbital margin of the carapace, armed with six or seven teeth on the upper surface, of which the last two are on the gastric region; none on the lower surface. Pleon laterally compressed, carinated from the anterior portion of the fourth somite, and terminating in a small tooth at the posterior extremity of the sixth somite. The ophthalmopod is short, being about half the length of the rostrum, and the ophthalmus is orbicular.

The first pair of antennæ carries a prosartema that is not so long as the ophthalmopod, and on the outer margin a short stylocerite which is scarcely as long as the eye, and a strong tooth arms the outer distal angle. The second joint is quite as long as the first, the third is short, and the flagella are rather more than twice the length of the peduncle.

The second pair carries a long and slender flagellum that is nearly three times the length of the animal; in one of the specimens it is spirally coiled, it having probably been injured, and is now undergoing renewal. The scaphocerite tapers distally and has a small tooth on the outer margin near the extremity. The synaphipod of the mandible reaches to the distal extremity of the last joint of the peduncle of the second pair of antennæ.

The first pair of gnathopoda carries an ecphysis that is about half the length of the meros, and is shorter and stouter than the second, which is long, slender, pediform and hirsute, and supports a rudimentary ecphysis.

The first pair of pereiopoda is a little more robust than the second, and is fringed on the anterior margin with long hairs, while the two next pairs have none.

The posterior two pairs of pereiopoda are long and slender, especially the last, which is as long as the entire animal, and when extended forward reaches considerably beyond the peduncle of the first pair of antennæ.

The pleopoda are short, and, as in *Penæus*, biramose, except the first pair, and they gradually decrease in length posteriorly.

Length (female), 76 mm. (3 in.).

Habitat.—Station 170, July 14, 1874; lat 29° 55′ S., long. 178° 14′ W.; off the Kermadec Islands; depth, 520 fathoms; bottom, volcanic mud; bottom temperature, 43°. Numerous female specimens. Trawled.

This species is generally large and robust. The teeth on the hepatic and frontal regions are longer and more spine-like, and the outer antennal tooth is post-marginal.

The first pair of antennæ has the peduncle rather longer than the rostrum, and the flagella about once and a half as long as the carapace; the first joint carries a short prosartema, and a strong, thick stylocerite that is nearly as long as the ophthalmopod.

The second pair of antennæ has the flagellum very long, being more than twice the length of the animal.

The pereiopoda are long, and each carries a small and almost rudimentary ecphysis attached to the second or basisal joint; the last two pairs are much longer, owing apparently to the extreme length of the ischium and meros. There are no teeth on the basis or meros of the first and second pairs of pereiopoda. The genital tubercles on the third pair meet in the ventral median line, and behind them, between the fourth pair, is a transverse tubercle, and between the fifth pair is a less prominent triangular tubercle.

Between the first pair of pleopoda is a small tooth, and between the second a transverse ridge. The inner branch on the first pair in our specimens, which are all females, is very rudimentary, and the other pairs are not remarkable for their length.

The posterior pair of pleopoda, which helps to form the rhipidura, has the outer plates scarcely longer than the inner, and the outer margin is strengthened by a ridge terminating in a subapical tooth, and marked by an imperfect diæresis.

The telson is long, tapering, dorsally depressed in the centre, armed on each side with a long, sharp, spine-like tooth, and terminates in a sharp and styliform point.

The ventral aspect of this species, of which we only know the female, differs from that of other species in having a large, prominent and pointed tubercle in the median line, posterior to the enlarged coxæ of the third pair of pereiopoda (fig. 2″ ♀). The posterior somites are not remarkable, and the first pair of pleopoda is only of generic importance.

Haliporus curvirostris, Spence Bate (Pl. XLII. fig. 1).

Haliporus curvirostris, Sp. B., *loc. cit.*

Carapace submembranous, long-ovate, covered with fine, short, hair-like spines, more abundant near the cervical fissure. Rostrum one-sixth the length of the carapace, anteriorly depressed and curved downwards, armed with ten or eleven small teeth on the crest, five of which are on the rostrum and the rest anterior to the cervical groove; a small carina exists in the median line, which culminates in two or three small teeth as it approaches the posterior margin.

Pleon smooth. The first somite is long, broad, and has the coxal plate large and well developed, slightly overriding the posterior margin of the carapace. Second somite rather longer than the first; the others subequal. Fifth and sixth terminating posteriorly in a small, sharp, dorsal tooth.

Rhipidura long, lateral plates narrow.

Telson long, narrow, dorsally grooved, laterally depressed, fringed with hairs, and armed with three small sharp teeth on the lateral margin.

Ophthalmopoda small, about half the length of the rostrum; ophthalmus not larger than the diameter of the ophthalmopod.

First pair of antennæ with the peduncle more than twice the length of the rostrum.

Second pair of gnathopoda extending considerably beyond the extremity of the scaphocerite.

Pereiopoda long, particularly the posterior pair.

Length (female), 88 mm. (3·5 in.).

Habitat.—Station 281, October 6, 1875; lat. 22° 21′ S., long. 150° 17′ W.; Pacific Ocean, south of the Low Archipelago; depth, 2385 fathoms; bottom, red clay; bottom temperature, 34°·9. One specimen (damaged). Trawled.

Station 285, October 14, 1875; lat. 32° 36′ S., long. 137° 43′ W.; South Pacific Ocean; depth, 2375 fathoms; bottom, red clay; bottom temperature, 35°·0. One specimen; female. Trawled.

This species may readily be distinguished from any of the others by the numerous small points that cover the carapace, by the marked curvature of the rostrum, the apex of which points downwards, and by the length and robustness of the posterior pair of pereiopoda.

The ophthalmi are not larger than the diameter of the stalk which supports them, which is scarcely half the length of the first joint of the peduncle of the first pair of antennæ, and the ophthalmic tubercle is small but prominent.

The peduncle of the first pair of antennæ is considerably longer than the rostrum, which equals the first joint, and carries a prosartema of a nodular and almost rudimentary form supporting a tuft of hairs. In the more perfect specimen the flagella are

broken off, but I suppose they are long and slender, as in the other species. The stylocerite is reduced to a rudimentary condition.

The second pair of antennæ possesses a scaphocerite that reaches beyond the distal extremity of the peduncle of the first pair, and the synaphipoda of the mandibles equal it in length. The second pair of gnathopoda extends to nearly the length of the carapace beyond the frontal margin, but supports only the rudiment of an ecphysis attached to the basisal joint.

The anterior three pairs of pereiopoda are moderately long and very slender; the posterior two pairs are very long and slender but rather more robust than those of other species, their great length being due to that of the meral and carpal joints.

The pleon is free from the small spines so characteristic of the carapace, and is smooth, except that it has a small tooth at the posterior extremities of the dorsal surface of the last two somites, and a longitudinal ridge that traverses the lateral walls of the several compressed somites in a position corresponding with the union of the somites to the coxal plates.

The tip of the telson is broken, but as it is it reaches very nearly to the extremity of the inner branch of the tail fan, which is nearly equal in length to the outer branch, which carries a small tooth on the outer side near the distal extremity, and possesses an imperfect diæresis. The branchiæ are arranged as in the type species, but the mastigobranchial lash consists of long and broad plates attached transversely to long pedicles.

Like many of the specimens recorded from extreme depths, the external tissue is of a submembranous character.

This species is represented in the collection by two specimens taken near the middle of the South Pacific Ocean at a depth of nearly three miles.

Haliporus lævis, Spence Bate (Pl. XLII. fig. 2).

Haliporus lævis, Sp. B., *loc. cit.*

Carapace submembranous, smooth, free from small hairs or spines over the surface.

Rostrum about one-fourth the length of the carapace, horizontal, straight, armed on the upper surface with six teeth, and two larger and more distant on the gastric region; one orbital tooth and one in a line posterior; one antennal tooth, one immediately behind it, and one on the hepatic region.

The pleon is laterally compressed, smooth, and slightly carinated dorsally. The sixth somite terminates abruptly, with a tendency to form a small tooth.

Telson long and slender, laterally compressed and grooved dorsally, armed with one long spine-like tooth on each side near the extremity.

Ophthalmopod half the length of the rostrum; tubercle on the inner side small.

First pair of antennæ with the flagella about two-thirds the length of the animal, and the flagellum of the second pair rather longer than the animal.

Rhipidura with the rami long and narrow.

This species is long and slender.

Length (female), 63 mm. (2·5 in.).

Habitat.—Station 104, August 23, 1873; lat. 2° 25′ N., long. 20° 1′ W.; Atlantic Ocean, south-west of Sierra Leone; depth, 2500 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·6. Two specimens; females.

Station 106, August 25, 1873; lat. 1° 47′ N., long. 24° 26′ W.; Atlantic Ocean, south-west of Sierra Leone; depth, 1850 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·6. One male, damaged and imperfect.

Station 205, November 13, 1874; lat. 16° 42′ N., long. 119° 22′ E.; off Manila, Philippines; depth, 1050 fathoms; bottom, blue mud; bottom temperature, 37°. One specimen; female.

This species differs from *Haliporus curvirostris* in having the rostrum (which is broken in our selected specimen) straight and horizontal with the dorsal line, and in being armed with eight teeth on the upper margin, of which the posterior two are distant and situated on the median ridge of the carapace. With the exception of the teeth on the frontal and hepatic regions, the whole surface of the animal is smooth and polished.

The cervical fossa is distinct, and the branchial and hepatic regions are defined by well marked lines.

The ophthalmi are small, being only a little broader than their stalk, which is about half the length of the rostrum and furnished on the inner side with a small blunt tubercle; they rest in a hollow on the upper surface of the first joint of the peduncle of the first pair of antennæ, which is about as long as the rostrum and furnished on the inner side with a short prosartema, and on the outer side with a short stylocerite and a sharp tooth at the distal angle. The second joint is nearly as long as the first, and the third is short, and the three which form the peduncle reach considerably beyond the rostrum, even to twice its length, and terminate in two long slender flagella that are more than half the length of the animal.

The second pair of antennæ carries a scaphocerite that reaches as far as the distal extremity of the peduncle of the first pair; it is narrow and terminates on the outer side in a subapical tooth. The peduncle supports a slender flagellum that is about twice the length of the animal.

The mandible possesses a large and foliaceous synaphipod, the second joint of which is more slender than the first, and it reaches as far forwards as the extremity of the peduncle of the second pair of antennæ.

The second gnathopod is broken in all the specimens, so that I cannot compare its length with other parts, except so far as to show that the basecphysis is relatively the same as in *Haliporus curvirostris*.

The pereiopoda are long and slender, especially the posterior two pairs.

Only one specimen of the male, and that considerably damaged, was taken off the Philippines. Neither the ventral surface of the male, nor the petasma attached to the first pair of pleopoda, is perfect enough for description. The female has the sexual tubercular process on the third pair of pereiopoda very large, and covered with stiff, short hairs; posterior to which, arising from the ventral surface on each side, is a stout process directed backwards and inwards and sparsely covered with short hairs. In the median line between these processes is a narrow, straight-sided vertical projection, broken at the apex, and posteriorly is the lateral bar, marking the posterior limits of the pereion, and on the first somite of the pleon, between the pleopoda, is a pointed process beneath which a nervous ganglion lies.

The specimens are all of a semitransparent and submembranous structure, and live at a depth of about three miles, where the temperature is only 4°·6 F. above the freezing point.

The solitary female specimen, taken near the Philippine Archipelago, does not on the closest comparison exhibit any difference from the Atlantic specimens; it was captured at a depth of one mile and a quarter, and where the temperature was 5° F. above freezing point.

Haliporus neptunus, Spence Bate (Pl. XLII. fig. 3).

Haliporus neptunus, Sp. B., *loc. cit.*

This species closely resembles *Haliporus equalis*, and a very close comparison of the two species externally has failed to show that there is any differentiating feature to distinguish them, except that in *Haliporus neptunus* the flagella of the superior antennæ are shorter, and the form of the parts on the ventral surface of the pereion differs.

The coxal process of the third pair of pereiopoda in the female is large and like the same part in *Haliporus equalis;* there is a transverse lunate process behind them, but the coxal process of the fourth pair of pereiopoda is rounded instead of being sharp; and posteriorly in the median line is a narrow longitudinal prominence, instead of the broad shield-like plate as in *Haliporus equalis*. In the male the petasma between the first pair of pleopoda terminates in three prominent processes like a trident, hence the specific name.

Length (male and female), 63 mm. (2·5 in.).

Habitat.—Station 191, September 23, 1874; lat. 5° 41′ S., long. 134° 4′ 30″ E.; off the Arrou Islands; depth, 800 fathoms; bottom, green mud; bottom temperature, 39°·5. Trawled. Two specimens.

Station 196, October 13, 1874; lat. 0° 48′ 30″ S., long. 126° 58′ 30″ E.; near the Philippines; depth, 825 fathoms; bottom, hard ground; bottom temperature, 36°·9. Three specimens; one female and two males, one of the latter not fully developed. Trawled.

This species appears to be readily detected by its colour. All the others are pale and transparent, while the specimens of this species are all of a ferruginous red, although they were taken at two stations separated by five degrees of latitude and eight of longitude from each other. They all lived at nearly the same depth, and under nearly the same temperature. Besides the variation in the ventral aspect of the two species, the form of the mastigobranchial plates corresponds more closely with those of *Haliporus obliquirostris* than with those of *Haliporus equalis*.

It may be that the three forms are only varieties adapted to variable conditions of habitat; but resting upon the extent of our present knowledge of species, I consider myself justified in separating them from each other, if only to demonstrate that variable parts may under different conditions become permanent or specific characters.

Sicyonia, Milne-Edwards.

Sicyonia, Milne-Edwards, Ann. d. Sci. Nat., ser. 1, tom. xix. p. 339, 1830; Hist. Nat. Crust., t. ii. p. 408.

Dermal structure extremely hard and rigid. Laterally compressed; anterior portion of the carapace and posterior portion of the pleon more compressed than the central region. Carapace furnished with a short rostrum, generally denticulated on the upper surface.

The ophthalmopod is short. Ophthalmus reniform.

The first pair of antennæ carries a sharp stylocerite and a rudimentary prosartema, and terminates in two subequally short flagella.

The second pair of antennæ supports a scaphocerite that is broad at the base, narrow at the apex, strong and rigid on the outer side, and terminates in a strong sharp tooth, and the peduncle carries a moderately long flagellum.

The oral appendages resemble those of *Penæus* generally, but differ in some details, as may be seen in the description of *Sicyonia carinata*, which I have taken as being typical of the genus.

The first pair of gnathopoda carries a mastigobranchial plate without a podobranchia attached to it, one arthrobranchial and one pleurobranchial plume, but no basecphysis.

The second pair of gnathopoda has a long and slender mastigobranchia, one arthrobranchial and one pleurobranchial plume, but no basecphysis.

The anterior three pairs of pereiopoda are short, chelate, and carry a long and slender

mastigobranchia, one arthrobranchial and one pleurobranchial plume, but no basecphysis. The penultimate pair carries the rudiment of an arthrobranchial plume in the form of a small papilla, and one well developed pleurobranchia. The posterior pair is stout, short, and carries no mastigobranchia, plume, nor basecphysis. On the ventral surface, between the fourth pair, a large sharp tooth, flat and broad at the base, lies directed anteriorly and reaches as far as the second pair, and between the fifth or posterior pair in the male the foramen for the passage of the vas deferens, instead of being situated on the coxa, is placed on the ventral portion of the last somite of the pereion.

The pleopoda are all single-branched and very short; the anterior pair in the male is furnished with a petasma that is cincinnulated in the median line.

The second pair has the inner branch developed in the form of a petasma of a somewhat less pronounced condition than that of the first pair. The other pairs are simple, and the posterior forms the lateral plates of the rhipidura.

The branchial arrangement is shown in the following table :—

Pleurobranchiæ,	.	.	.	1	1	1	1	1	1	...
Arthrobranchiæ,	.	.	.	1	1	1	1	1	r	..
Podobranchiæ,	.	.	.	...	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	1	1	1	1	1	...	...
				h	i	k	l	m	n	o

This genus was described by Milne-Edwards in 1830, and embraced three species, *Sicyonia sculpta*, Milne-Edwards, from the Mediterranean, *Sicyonia carinata* (Olivier), from Rio Janeiro, and *Sicyonia lancifer* (Olivier). He describes the genus as being very near to *Penæus*, which it resembles in the compressed form of the body, in the termination of the first pair of antennæ, in the didactylous hands possessed by the first three pairs of legs, in the conformation of the pleopoda and in other details. But it differs most essentially in the structural character of the branchiæ, in the absence of any traces of pleurobranchiæ, in the reduction of the arthrobranchial plumes, and in the presence of one podobranchial plume attached to the first pair of gnathopoda; the branchiæ divide as in *Penæus*, but instead of being filamentous they are foliaceous in structure, and thus approximate to the condition seen in *Gennadas* and *Sergestes*.

Geographical Distribution.—In the Challenger collection there are four species; one from the West Indies, which I take to be closely allied to *Sicyonia carinata*, from which it differs in what may be only sexual features; one from Torres Strait, that closely resembles the figure of *Hippolyte cristatus*, de Haan, from the Japanese Seas, and coincides with the description of *Sicyonia lancifer* (Olivier), the habitat of which is stated to be the Indian Ocean; and the third is from the north side of New Guinea. This, together with the type, *Sicyonia sculpta*, that was taken in the Bay of Naples, and one described by Stimpson from the Chinese seas under the specific name of *Sicyonia ocellata*, gives the geographical distribution of this genus exceptional interest.

The following list, giving all the known localities, defines the geographical limits of the genus :—

Sicyonia sculpta, Milne-Edwards; Mediterranean, Cape Verde Islands.
Sicyonia carinata (Olivier); South America and West Indies.
Sicyonia (*Hippolyte*) *cristata*, de Haan; Japan. Gulf of Kagosima, Stimpson.
Sicyonia (*Hippolyte*) *parvula*, de Haan; Japan. Gulf of Kagosima, Stimpson.
Sicyonia (*Hippolyte*) *bispinosa*, de Haan; Japan.
Sicyonia ocellata, Stimpson; China.
Sicyonia lancifer (Olivier); Indian Ocean.
Sicyonia lævis, n. sp.; New Guinea.

Sicyonia sculpta, Milne-Edwards (Pl. XLIII. fig. 1).

Sicyonia sculpta, Milne-Edwards, Ann. d. Sci. Nat., ser. 1, t. xix. p. 339, pl. ix. figs. 1–8, 1830; Hist. Nat. Crust., tom. ii. p. 409.

Rostrum as long as the peduncle of the first pair of antennæ; six large teeth on the dorsal crest of the carapace, and a solitary tooth on the under surface near the point of the rostrum. Flagellum of the second pair of antennæ slender and cylindrical.

Length about 50 mm. (2 in.).

Habitat.—Off St Vincent, Cape Verde Islands, and "The Mediterranean Sea." (Milne Edwards).

Such is Milne-Edwards' description of this species, with which our specimen, that was taken off St. Vincent, Cape Verde Islands, seems to agree. There are six teeth on the dorsal crest, the two larger ones are on the posterior half of the carapace, and the four others are smaller and gradually lessen from the gastric region to the extremity of the rostrum. There is a small tooth on the under surface near the point of the rostrum, but this appears to be common to all the known species.

The dorsal surface of the pleon is elevated into a narrow carina, of which the anterior portion on the first somite is produced to a small tooth, directed forwards, while that on the posterior extremity of the sixth somite is directed backwards.

The telson is shorter than the lateral plates of the rhipidura.

Length about 30 mm. (1·25 in.).

Sicyonia carinata (Olivier) (Pl. XLIII. figs. 2, 3).

Palæmon carinatus, Olivier, Encyclop., t. viii. p. 667.
Sicyonia carinata, Milne-Edwards, Ann. d. Sci. Nat., ser. 1, t. xix. p. 344, pl. ix. fig. 44; Hist. Nat. Crust., t. ii. p. 410.
„ „ Dana, *loc. cit.*, p. 602, pl. xl. fig. 1.

The dorsal surface is carinated in the median line from the rostrum to the posterior somite of the pleon. Carapace with a short rostrum directed obliquely upwards, armed

with two small teeth, with indications of a third at the extremity, and with two larger teeth posterior to the gastric region; a short tooth on the anterior margin of the carapace, corresponding with the external orbital angle, and one posterior on the hepatic region.

The dorsal carina on the first somite of the pleon is produced into an anteriorly directed tooth, and on the sixth into a posteriorly directed one.

Telson tapering, dorsally depressed, and nearly equalling the lateral rami of the rhipidura in length.

Habitat.—St. Thomas, West Indies, in shallow water. One specimen; male.

Off Bahia, 20 fathoms. One specimen; female.

Our specimens differ in some details from Milne-Edwards' description and figure, but not sufficiently to mark it as specifically distinct.

Milne-Edwards' figure has the ophthalmopod long and cylindrical, but this may be, and probably is, only an artistic misrepresentation, and the flagella of the first pair of antennæ are represented as being very short, and the peduncle of the second pair of antennæ reaches nearly to the extremity of the scaphocerite, and the terminal flagellum is flattened and strongly ciliated on both borders.

The rostrum in our specimen is smooth below and directed obliquely upwards and forwards; it has on the dorsal surface two small teeth; an anterior apical one, only determinable with a lens, and a posterior one directly over the orbital margin, whereas Milne-Edwards says there are two small teeth and both near the point, although he figures a third as a rudimentary one on the under side of the apex. Behind these, on the dorsal surface, are two others in the median line, corresponding with Milne-Edwards' description, as also does the general plan, but the appendages of the animal require further description in detail.

In the Challenger specimen from the West Indies, there is no tooth on the lower surface. In that from the coast of South America there is one on the lower margin.

The ophthalmopod is very short and biarticulate, a small appendage being attached to the first joint; the ophthalmus, forming the larger portion, is broad, reniform, flattened on the inner side and rounded on the outer, and reaches anteriorly beyond the extremity of the rostrum.

The first pair of antennæ (fig. 3, *b*) has the first joint longer than the eye, deeply excavated and thickly fringed with hairs on the upper surface to receive and protect the eye when at rest; the inner margin is straight and in contact with its fellow throughout its entire length; the prosartema is rudimentary and the stylocerite is almost as long as the joint, and is separated nearly to the base, while another sharp tooth at the outer angle projects forwards to nearly half the length of the second joint, which is short and cylindrical, as also is the third, which carries at its extremity, in the male specimen, two slender flagella that are about half the length of the peduncle.

The second pair of antennæ (fig. 3, *c*) carries a triangular scaphocerite, that is stiff and rigid on the outer side and deeply cleft at the extremity by a long slit between the spine and the foliaceous portion. The terminal joint of the peduncle extends to about half the length of the scaphocerite, and in this respect differs from Milne-Edwards' description, wherein he says that it "nearly reaches the extremity of the scale which covers it." The flagellum is slightly compressed, and its length is about half that of the animal, and the phymacerite is implanted on the inner side.

The mandibles are large and very robust; the psalisiform margin is smooth and connected with a large, smooth, molar disc, and carries a strong foliaceous, two-jointed synaphipod.

The first pair of siagnopoda is three-branched, and resembles that of the genus *Gennadas* rather than the true *Penæus*.

The second pair of siagnopoda very closely resembles that of *Penæus*, differing only in having the first branch with its two foliaceous plates smaller.

The third pair of siagnopoda differs from that of *Penæus* in having the central branches shorter.

The first pair of gnathopoda resembles that of *Penæus* in the manner in which the terminal three joints are reflexed upon the inner and under surface, but differs in having the meral joint so thin and broad that it overlies and covers the terminal joints. The coxa carries a long and slender mastigobranchia shaped like that in *Penæus*, and, as in that genus, there is no branchial plume attached to it, and not even the rudiment of any basecphysis—an appendage that is so generally present in the Penæidea.

The second pair of gnathopoda is long, slender, and pediform; it carries no basecphysis and terminates in a dactylos that is oval and spatuliform. The mastigobranchia appears to be absent from this limb, also one of the arthrobranchia and the pleurobranchial plume.

The anterior three pairs of pereiopoda are chelate and carry no branch on the basisal joint, but a long and forked mastigobranchia, similar to those of *Penæus*, and two arthrobranchial plumes. The posterior two pairs are short, stout, and simple, and have neither branch, branchial lash, nor plume.

The ventral surface in our male specimen is furnished with a long and formidable styliform tooth, that originates on the penultimate somite of the pereion and reaches as far forwards as the coxa of the second gnathopod. In the female a similar broad-based ventral tooth exists, and behind it is a broad plate connected with the posterior somite of the pereion, and passing back to the posterior margin of the pereion.

The first pair of pleopoda carries a longitudinally folded petasma that meets its corresponding fellow and unites with it by several small hooks, and on the second pair is a second petasmiform appendage that terminates in a condyloid extremity, but does not unite in the median line. All the other pleopoda are single-branched, except the posterior

pair, which goes to form the outer plates of the tail-fan; this is biramose and supported by strong longitudinal ridges, the outer marginal one is very strong and terminates in a sharp tooth, short of the terminal extremity, in connection with a well-defined diæresis.

Observation.—The specimen supposed to be the type of *Palæmon carinatus*, from which M. Olivier drew his description, was found in the Museum of the Jardin des Plantes without any indication of the locality where it was obtained, but if it be the same as that author described, it was brought from New Holland by Péron, but that which Milne-Edwards gives in his Histoire naturelle des Crustacés came from Rio Janeiro, where Dana also procured some specimens and says that it is common.

Sicyonia lancifer (Olivier) (Pl. XLIII. fig. 4).

Palæmon lancifer, Olivier, Encyclop., t. vi. p. 664, pl. cccxvii. fig. 2.
Sicyonia lancifer, de Haan, Siebold's Fauna Japonica, p. 194.
Hippolyte cristata, de Haan, *loc. cit.*, Tab. xlv. fig. 10.
Sicyonia lancifer, Milne-Edwards, Ann. d. Sci. Nat., ser. 1, t. xix. p. 341, note, 1830; Hist. Nat. Crust., vol. ii. p. 410.
Sicyonia cristata, Stimpson, Prodromus descrip. Crust. mac.; Proc. Acad. Nat. Sci. Philad., p. 112, 1860.

The rostrum is obliquely elevated; armed with a single tooth on the lower surface at the extremity; crested on the dorsal median line of the carapace, and armed with four small teeth on the rostrum, four larger ones posteriorly, and one large sharp tooth on the hepatic region.

The pleon is carinated and but slightly compressed laterally. The carina on the first somite is produced anteriorly to a small tooth, and on the last to a large one directed posteriorly; the carina on each somite is double-ridged longitudinally, and cleft posteriorly to receive that of the next succeeding somite. The last three somites have the coxal plates posteriorly produced to sharp teeth. The telson is tapering and terminally flanked by a sharp tooth on either side, and with a fringe of strong hairs.

Length (female), 50 mm. (2 in.).

Habitat.—Station 188, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; Arafura Sea, south of Papua; depth, 28 fathoms; bottom, green mud. One specimen; female.

This specimen appears to me to coincide with Milne-Edwards' description of *Sicyonia lancifer* (Olivier). De Haan's figure of *Sicyonia* (*Hippolyte*) *cristata* also corresponds with the Challenger specimen, and the descriptions of the two agree with that given by Olivier under the name of *Palæmon lancifer*. There is but one specimen in the collection, and that a female. It is less compressed laterally, both anteriorly and posteriorly, than *Sicyonia carinata*; the teeth are more numerous on the median dorsal ridge, and

the one on the hepatic region is considerably enlarged. The carina on the pleon, as pointed out by Olivier, is "flattened on the summit and ridged at the margin"; this is caused by a cleft existing in the median line of the posterior margin, which admits of the crest of the next somite being raised into it, and thus a more extensive vertical movement is provided. This peculiar condition I have seen in other carinated species of Crustacea, but to a less conspicuous extent.

The postero-lateral margins of the coxal plates are strongly denticulated. The first and second are only dentate at the apex; the third is bidentate, the fourth and fifth are tridentate, the posterior tooth being smallest. The sixth or posterior is bidentate, and has also a tooth in the median dorsal line. The body generally is pilose, and the margins of the pleonic somites are fringed with hairs.

The ophthalmopoda are short, being about half the length of the rostrum.

The first pair of antennæ is short, having the first joint of the peduncle scarcely longer than the rostrum; it carries a small prosartema and a long stylocerite that reaches nearly to a level with the distal extremity of the first joint, the outer angle of which terminates in a strong tooth; the second joint is short and cylindrical, and the third is very short and carries two very small and slender flagella.

The other appendages are very like those of the preceding species, except that the second pair of gnathopoda is scarcely so long and is more robust.

The ventral surface of the pereion is hirsute, especially marked on the coxal and basisal joints of the pereiopoda. In our specimen the ventral plate or thelycum commences between the ultimate pair of pereiopoda, and projects in the form of a sharp styliform tooth as far forwards as the second pair of pereiopoda, a deep hollow existing in the median line at the base; between the anterior pairs of pereiopoda is a pair of sharp spine-like teeth, and between every pair of pleopoda is a strong tooth-like tubercle.

This specimen was taken south of New Guinea. De Haan records his specimen from Japan. Dr. Stimpson found his in 20 fathoms of water on a bottom of shells and sand in the Gulf of Kagosima, and M. Péron brought the typical specimen, described by M. Olivier, from "la mer des Indes."

Sicyonia lævis, n. sp. (Pl. XLIII. fig. 5).

Surface of the animal smooth.

Rostrum armed with five teeth above, and one below at the apex, and on the dorsal crest with two in the median line, one on the gastric region and the other on the cardiac, whence a small carina extends to the posterior margin of the carapace. Hepatic tooth small. Pleon slightly carinated. First and second somites armed with an anteriorly directed tooth; posterior margin of each somite cleft in the dorsal median line, last somite

armed with a posteriorly directed tooth, the extremity of which is depressed. Lateral margins of the coxal plates unarmed.

Telson subequal with the rami of the rhipidura.

Length (male) 30 mm. (1·25 in.).

Habitat.—Station 219, March 10, 1875; lat. 1° 54′ S., long. 146° 39′ 40″ E., north of New Guinea; depth, 150 fathoms; bottom, coral mud. One specimen; male.

This species differs from all those already described in the absence of deeply embossed markings on the surface, and in the less pronounced condition of a series of vertical ridges that mark the posterior portion of each somite of the pleon.

The rostrum is slightly elevated, bidentate at the tip, smooth on the lower margin; the teeth on the upper margin are rather larger than in the other species. The ophthalmus is large, reaching nearly to the extremity of the rostrum. The orbital angle is produced to a point and the tooth on the hepatic region is rather small. The teeth on the dorsal surface of the carapace are also small and not very elevated; the anterior stands on the gastric region and the posterior immediately behind the cervical fossa, whence a low but sharp carina extends to the posterior margin of the carapace.

The first pair of antennæ is short; the prosartema is rudimentary; the stylocerite falls short of the extremity of the first joint of the peduncle; the two succeeding joints are short and terminate in a pair of small and slender flagella, that are not as long as the last two joints.

The mandible carries a synaphipod that is broad and flat.

The first pair of gnathopoda is tolerably robust and hirsute, the second is long and slender. The anterior three pairs of pereiopoda are slender; the second is the longest, the third very short, and the posterior two pairs are slender but not so long as the third pair. The ventral tooth is long and styliform. Our specimen is smaller than those of the other known species, but has all the features of an adult animal. It is a male, and carries the protuberance on the ventral surface near and posterior to the coxa of the fifth pair of pereiopoda.

Hemipenæus, Spence Bate.

Hemipenæus, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol viii. p. 186, 1881.

Animal slender, carapace without an hepatic tooth, rostrum short, horizontal, dentate. Pleon compressed. Telson shorter than the outer rami of the rhipidura.

Ophthalmopod single-jointed, having a small tubercle on the inner side. First pair of antennæ has the peduncle longer than the rostrum and terminates in two unequal flagella, the shorter of which arises from near the base of the terminal joint, the longer at the apex; the first joint carries a rudimentary prosartema, and the stylocerite is want-

ing, or is confluent with the margin. The second pair of antennæ has a long and wide scaphocerite, strengthened on the outer side by a ridge that terminates in a sharp tooth, near the distal extremity, and it carries a long and slender flagellum. The siagon or mandible carries a two-jointed synaphipod that does not reach beyond the second joint of the peduncle of the second pair of antennæ.

The first pair of gnathopoda is subpediform and carries a long and slender basecphysis. The second pair is very long, slender, and carries a very long basecphysis.

The anterior three pairs of pereiopoda are long and slender, and the dactyli are long. The posterior two pairs of pereiopoda are slender, but not quite so long as the preceding.

The pleopoda are long, slender, and unequally branched.

In its external appearance this genus approximates to *Penæus*, but it may readily be distinguished by the character of the ophthalmopod, the rudimentary state of the prosartema, and the condition of the stylocerite of the first pair of antennæ, as well as by the difference in the character of the branchiæ. In this genus a podobranchial plume is attached to each of the five mastigobranchiæ, and two arthrobranchial plumes are attached to the antepenultimate pair of pereiopoda.

In these two latter characters the branchial arrangement approximates to that of the genus *Benthesicymus*, from which it differs, first, in having no mastigobranchia attached to the penultimate pair of pereiopoda, and, second, in a character that might be thought to possess only specific or even only varietal value, but which in reality is important: in *Benthesicymus* the mastigobranchial plates increase in size posteriorly, and the last is the longest, and is a very important appendage, and all the podobranchial plumes are large and well developed, and the pleurobranchiæ, although more important posteriorly than anteriorly, are all large and useful organs, whereas in *Hemipenæus* the pleurobranchiæ are all small and feeble organs, except the posterior pair, and the podobranchiæ are also small, those of the third pair of pereiopoda being very feeble, and the mastigobranchiæ are absent from the last, and exist only as rudimentary lobes on the penultimate pair.

The arrangement may be tabulated in the following formula:—

Pleurobranchiæ,	...	...	1	1	1	1	1		
Arthrobranchiæ,	2	2	2	2	2	2	...		
Podobranchiæ,	1	1	1	1	1	...	...		
Mastigobranchiæ,	1	1	1	1	1	...	...		
	h	i	k	l	m	n	o		

The structure of the branchiæ also differs from that of *Benthesicymus*, and corresponds more with that of *Penæus*, each plume consisting of a central stalk which carries a series of club-shaped filaments, each branch curling over so that the extremities of opposite branches approximate, and the whole plume forms an obliquely truncated or pen-shaped tube.

Hemipenæus spinidorsalis, Spence Bate (Pl. XLIV. fig. 1).

Hemipenæus spinidorsalis, Sp. B., *loc. cit.*, p. 186.

Rostrum longer than the ophthalmopoda, thin, armed with three teeth on the dorsal surface; crest not elevated; inferior margin smooth and fringed with hairs.

Pleon having the third somite dorsally carinated posteriorly, from the crest of which a long, slender, posteriorly curved tooth projects, and a small dorsal ridge traverses the posterior somite longitudinally in the median line and terminates in a minute tooth.

Telson half the length of the outer ramus of the rhipidura.

The ophthalmopoda are slender, furnished with a small tubercle on the inner margin, and terminate in an orbicular, dark brown ophthalmus.

The first pair of antennæ has the first joint of the peduncle nearly as long as the rostrum, and supports a strong stylocerite that is confluent with the margin, and reaches nearly to the extremity of the joint; the second joint is as long as the first, and subcylindrical; third joint short, carrying two flagella, one long and slender, and the other short, flat and broad, the former articulating at the extremity, the latter at the base.

The second pair carries a scaphocerite that is twice as long as the peduncle of the first pair, and is armed on the outer margin with a small, sharp, subapical tooth; flagellum twice as long as the animal.

The first three pairs of pereiopoda have the chelæ long and slender, the pollex and dactylus being twice the length of the palm; the last two pairs are long, slender, feeble and styliform.

The pleopoda are very long, the first pair is single-branched, and the succeeding pairs have a very slender second branch. The terminal pair is long, narrow, and unequally branched; the outer branch being much longer than the inner, terminating in an ovate extremity, and furnished with a tooth on the outer margin.

Habitat.—Station 133, October 11, 1873; lat. 35° 41′ S., long. 20° 55′ W.; near Tristan da Cunha; depth, 1900 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·4. Two damaged specimens. Trawled.

Station 213, February 8, 1875; lat. 5° 47′ N., long. 124° 1′ E.; near the Philippines; depth, 2050 fathoms; bottom, blue mud; bottom temperature, 38°·8. One specimen. Trawled.

Length, male, 63 mm. (2·5 in.); female, 57 mm. (2·25 in.).

This species, which is remarkable for a spine-like tooth on the third somite of the pleon, has been taken in both the Pacific and Atlantic Oceans. The specimens from the above localities correspond with each other very closely, even in apparently unimportant details. Two of the teeth on the rostrum are situated near together in front of the

orbital margin, the third is more distant, and behind the marginal line of the orbit. The dorsal surface is horizontal, especially marked in the smaller specimen.

The ophthalmi are well developed, not large, but situated on tolerably long and slender ophthalmopoda.

The chelæ are long and slender, and the digital processes are longer than the rest of the hand.

The pleopoda are long, and similar to those of species in allied genera.

The telson is laterally fringed with hairs, and armed with three, small, spine-like teeth.

This is a deep-sea species, having been obtained from a depth of more than two miles in one case, and more than three in the other.

Hemipenæus gracilis, n. sp. (Pl. XLIV. fig. 2).

Very like *Hemipenæus spinidorsalis*, but without the dorsal tooth on the third somite of the pleon. Telson scarcely half the length of the outer ramus of the rhipidura.

Length, male, 50 mm. (2 in.); female, 50 mm. (2 in.). The female is the more robust.

Habitat.—Station 207, January 16, 1875; lat. 12° 21′ N., long. 122° 15′ E.; off Tablas Island, Philippines; depth, 700 fathoms; bottom, blue mud; bottom temperature, 51°·6. Six specimens; two male, two female, and two young.

This species bears so close a resemblance to *Hemipenæus spinidorsalis*, that I could not discover any difference sufficiently important to determine specific distinction, except the absence of the characteristic dorsal tooth on the third somite of the pleon.

On comparing specimens of similar size side by side, it is seen that in *Hemipenæus spinidorsalis* the rostrum is scarcely shorter, and projects less in advance of the eyes, and the eye in *Hemipenæus gracilis* is wider than the stalk, and black instead of brown.

All the appendages bear a close resemblance to one another; the chelæ are slender, and the fingers longer than the palm.

The ventral surface of the pereion varies somewhat, projecting forward in this species in the form of a flat, broad-based and sharply pointed tooth, whereas in *Hemipenæus spinidorsalis* it is obtuse at the point, but the difference is not such as to separate them specifically; and certainly had there not been in the collection specimens of both males and females of this species, I should have considered them as being probably only sexually distinct.

The habitats of the two, though not distant, differ much both in depth and in temperature.

Hemipenæus speciosus, Spence Bate (Pl. XXXVII. fig. 3; Pl. XLIV. fig. 3).

Hemipenæus speciosus, Sp. B., *loc. cit.*, p. 186.

Carapace dorsally carinated from the anterior to the posterior margin, and produced to a sharp anteriorly depressed rostrum that is armed with three teeth, one of which is immediately behind the orbital margin.

Ophthalmopod long, slender, transversely compressed and hairy; the ophthalmus scarcely broader than the stalk, which carries on the upper and inner surface a small but prominent tubercle. Body smooth. Pleon having the posterior half of the third somite elevated to a small carina, which is repeated at the posterior extremity of the fourth and continued on the fifth and sixth, where it terminates abruptly.

Telson about half the length of the outer ramus of the rhipidura, and furnished near the apex on each side with three small spinules.

Length, about 63 mm. (2·5 in.)

Habitat.—Station 325, March 2, 1876; lat. 36° 44′ S., long. 46° 16′ W., east of Buenos Ayres; depth, 2650 fathoms; bottom, blue mud; bottom temperature, 32°·7. Two specimens; one male and one female. Trawled.

This species bears some resemblance to *Hemipenæus spinidorsalis*, but the rostrum is sharper and more depressed anteriorly, and the last somite of the pleon is not produced posteriorly to a small tooth-like process. The ophthalmopod is slender, the eye is small, and the posterior two pairs of pereiopoda are rather more slender.

One of our specimens appears to be a male not yet well developed, and the other a female. They both have on the ventral surface a broad, smooth plate that occupies the entire space between the posterior pairs of pereiopoda, which is produced to a sharp point in the median line anteriorly.

Hemipenæus virilis, Spence Bate (Pl. XLIV. fig. 4).

Hemipenæus virilis, Sp. B., *loc. cit.*, p. 187.

Rostrum horizontal, pointed, smooth and ciliated on the lower margin, armed with three teeth on the upper surface, one of which is slightly posterior to the orbital margin; carina lost at the gastric region. Dorsal surface smooth; regions not clearly defined. Pleon dorsally compressed; a small carina commences at the fourth somite and terminates posteriorly in a small tooth on each of the last three somites.

Telson half the length of the rhipidura, pointed, dorsally flattened, and grooved in the median line, laterally fringed with hairs, and four small spines.

Length (male), 100 mm. (4 in.)

Habitat.—Station 200, October 23, 1874; lat. 6° 47′ N., long. 122° 28′ E.; near the Philippine Islands; depth, 250 fathoms; bottom, green mud. Two male specimens, one having the petasma more developed than the other. Trawled.

The general surface of the animal is slightly pilose. The rostrum is horizontal, pointed, is not elevated at the apex, and does not reach beyond the distal extremity of the first joint of the peduncle of the first pair of antennæ; the upper margin is armed with three teeth, of which the anterior is near the apex and the posterior behind the orbital margin, and they stand upon a small compressed carina which fades away upon the gastric region, and does not reappear until at the fourth somite of the pleon, where it is slightly elevated, and it terminates in a small tooth at the posterior extremity of each of the last three somites.

The ophthalmi are large, orbicular, and supported on short, narrow and compressed peduncles that have a small tubercle on the inner side close to the eye.

The first pair of antennæ has the peduncle twice as long as the rostrum, and the first joint has a stylocerite that lies in contact with the margin, and terminates in a tooth a little short of the outer distal angle, which is also produced to a sharp tooth; the second joint is nearly as long as the first, and the third carries on the outer side a short, flattened flagellum, and at the extremity one that is once and a half as long as the animal, and which has near the base a slight but unusual curve and twist, corresponding to the length of the outer flagellum, and apparently due to its oblique compression.

The second pair has the phymacerite projecting downwards and inwards, and the scaphocerite extending forwards beyond the distal extremity of the smaller flagellum, and in both specimens in the Challenger collection the margins are thickened. In one specimen this thickened tissue is limited to the outer distal margin, commencing just beyond the small tooth and fading away at the apex, but the structure beyond exhibits evidence of being affected. In the other specimen the same dense substance commences at the corresponding point, that is, at the fissure beyond the outer tooth, and continues to about halfway on the internal margin, where it gradually decreases and terminates. I believe this thickening to be the result of disease, but it appears to produce in some specimens a singular constriction of the organ that is worthy of consideration as producing alteration of form, which appears to resemble specific variation (*vide* Pl. L. *c.*).

The mandible carries a synaphipod of which the terminal joint is triangulate.

The first pair of gnathopoda carries a basecphysis that extends considerably beyond the dactylos. The second reaches as far as the extremity of the rostrum and supports a basecphysis that reaches to the extremity of the meros.

The pereiopoda approximate to each other ventrally, the coxæ of first three pairs being almost in contact. Between the fourth pair is a small, pointed, obliquely projecting plate. The coxæ of the posterior pair are developed to an unusually large size, and approximate to

each other, without being in contact, in the median line for the purpose of supporting the vas deferens.

The first pair of pleopoda is long and single-branched, and from near the base of the first joint a protuberance projects that supports the petasma, which consists of a large, ovate, membranous plate that is hooked by a series of cincinnuli to its fellow on the opposite pleopod. The second pair of pleopoda is two-branched; the outer or posterior branch is long, and resembles that of the first pair, the anterior or inner branch is small, short, and furnished at the base with a broad, thin, hollow, scale-like appendage; it is firm, rigid, and forms a sexual distinction. All the other pleopoda are similar to those in other species.

The outer branch of the tail-fan is long, narrow, and very nearly double the length of the telson, which is tapering, fringed at the margins with a row of short hairs and three or four small spines.

This form was taken associated with two or three other species, among which was *Hemipenæus tomentosus*, and in spite of the great difference in the length of the rostrum, I am greatly inclined to believe that the latter will prove to be the female of *Hemipenæus virilis*, and I only hesitate so to regard them because it is more common for the male animal to possess the stronger characters. *Hemipenæus tomentosus* appears to be intermediate in form between *Hemipenæus virilis* and *Hemipenæus semidentatus*.

Hemipenæus semidentatus, Spence Bate (Pl. XLIX. fig. 1).

Aristeus semidentatus, Sp. B., *loc. cit.*, p. 189.

Rostrum long and slender, about two-thirds the length of the carapace, rising slightly towards the anterior extremity; armed with three teeth on the dorsal surface just over the orbit. Pleon posteriorly compressed, slightly carinated, and produced to a small tooth at the posterior extremity of the last three somites.

Telson tapering to a sharp point, dorsally grooved and laterally compressed, having the margins fringed with hairs and armed with three small movable spines.

The ophthalmi are rather large, orbicular, and supported on short slender ophthalmopoda that narrow gradually to the base.

The first pair of antennæ has a peduncle that is rather more than half the length of the rostrum; the first joint has the stylocerite traversing the outer margin, resembling a strong ridge, and terminating in a sharp tooth at the distal angle, and on the inner side the prosartema is reduced to a tubercle tipped with a tuft of short hairs. The shorter flagellum is about the length of the second joint, and the longer one is about the length of the animal.

The second antenna has a prominent phymacerite, and supports a membranous scaphocerite that is rigid on the outer margin and reaches beyond the extremity of the

peduncle of the first pair, but not quite to the extremity of the rostrum, and terminates in a flagellum about once and a half as long as the animal.

The dactyli of the anterio rthree pairs of pereiopoda are long and slender.

The pleopoda are moderately slender and elongated.

Habitat.—Station 170, July 14, 1874; lat. 29° 55′ S., long. 178° 14′ W.; near the Kermadec Islands; depth, 520 fathoms; bottom, volcanic mud; bottom temperature, 43°·0. Three specimens.

Length, largest female 107 mm. (4·25 in.), smallest male 51 mm. (2 in.). Trawled.

Station 171, July 15, 1874; lat. 28° 33′ S., long. 177° 50′ W.; north of the Kermadec Islands; depth 600 fathoms; bottom, hard ground; bottom temperature, 39°·5. One specimen; female. Length 150 mm. (6 in.). Trawled.

Station 194, September 29, 1874; lat. 4° 34′ S., long. 129° 57′ 30″ E.; off Banda Island; depth, 200 fathoms; bottom, volcanic mud. One specimen; female. Length, 55 mm. (2 in.).

This species corresponds so closely in general appearance with Duvernoy's figure[1] of *Aristeus antennatus*, Risso, that it was only proved not to be a variety by comparing it with Risso's figure,[2] and by careful consideration of the details of the specimens in this collection. In Risso's figure it is without eyes, but at page 97 he says that "Les yeux sont gros, noirs, placés sur les courts pédicules;" he also says that "les antennes supérieures, ingalement bifides," and figures them subequal, slender, and not longer than the rostrum, and has the dorsal surface of the pleon smooth, "dont les deux (segmeros) derniers sont carénés." Duvernoy represents the eyes as standing on a long peduncle, but smaller in proportion to the diameter of the stalk than is the case in our specimens. He also figures the larger flagellum of the first pair of antennæ as being longer than that of the second, but this is probably an error in drawing. He also represents the dorsal surface of the pleon as being smooth, and the posterior margins of the fourth and fifth somites as produced in the median line to a point, whereas in the Challenger specimen the two somites are not so produced, but elevated into a small and distinct carina that terminates in a small point on the fifth and sixth somites, and in some specimens on the fourth also.

This species differs from *Aristeus armatus*, which it much resembles, in having the rostrum proportionally shorter, the teeth on the crest rather smaller, and none on the third somite of the pleon, where in *Aristeus armatus* it is very large, as are also those on the fourth and fifth somites, whereas in *Hemipenæus semidentatus* there is only a small carina which terminates almost abruptly.

The branchiæ in the Challenger specimens correspond with those of the other species

[1] *Ann. d. Sci. Nat.*, t. xv., 1841.

[2] Hist. Nat. Crust. des Environs de Nice, p. 96, pl. ii. fig. 6.

of this genus rather than with *Aristeus*, especially in the rudimentary condition of the pleurobranchiæ, and in having no mastigobranchia attached to the fourth pair of pereiopoda.

The outer branch of the tail-fan is long and narrow, about one-half longer than the inner, which is about one-fourth longer than the telson. The outer margin is strengthened by two parallel ridges that meet in a sharp tooth some distance from the distal extremity. From near this tooth a rigid diæresis obliquely traverses the plate.

A fine specimen of a female, about 150 mm. long, measured from the frontal margin to the extremity of the telson, was taken by the trawl about 130 miles north-east of the Kermadec Islands, and three others were also trawled at a depth of nearly three-quarters of a mile close to the same islands; these were one adult female and two young animals, one of which carries an antenna that is more than three times its length, and the smallest specimen appears to be an immature male.

Hemipenæus tomentosus, Spence Bate (Pl. XLIX. figs. 2, 3; Pl. L.).

Aristeus tomentosus, Sp. B., *loc. cit.*, p. 189.

Body smooth, covered with a very short velvety pile. Rostrum equal in length to the extremity of the shorter flagellum of the first pair of antennæ; armed with three teeth, of which the posterior is just behind the orbital margin of the carapace, the second in advance of it, and the third near the middle of the rostrum. The dorsal carina is only just indicated in the median line behind the posterior tooth, feebly repeated on the posterior portion of the third somite of the pleon, and increases on each of the three posterior somites, where it is produced to a small pointed tooth.

The telson is pointed, dorsally flattened, with indications of a groove, and armed on each side with three small spines.

Habitat.—Station 177, August 18, 1874; lat. 16° 45′ S., long. 168° 7′ E., the New Hebrides; depth, 130 fathoms; bottom, volcanic sand. One specimen; female.

Station 200, October 23, 1874; lat. 6° 47′ N., long. 122° 28′ E.; the Philippine Islands; depth, 250 fathoms; bottom, green mud. Two females.

Length (female), 125 mm. (5 in.).

This species bears a general close resemblance to *Hemipenæus semidentatus*, but is easily distinguished by the slightly pilose character of the external surface, and by the shortness of the rostrum, which is only half the length of the carapace. The teeth on the rostral crest are further apart and not so large. There is not a very distinct ridge traversing the upper margin of the branchial chamber, and the mid-branchial rib is but feebly marked. The teeth on the frontal margin of the carapace correspond with those of the typical species.

The dorsal surface of the several somites of the pleon is smooth, but in the fourth it is produced to a point, which in the two succeeding ones is increased to a decided tooth.

The telson tapers to a very sharp point, and has the sides compressed and the dorsal surface flattened and slightly grooved in the median line.

The ventral surface of the pereion is narrow; the oviducts on the third pair of pereiopoda come into contact in the median line. An almost vertical process, covered with short stiff hairs, lies between the coxæ of the fourth pair, behind which there is a circular depression bordered by a hirsute ridge between the coxæ of the fifth pair; the deep depression between the posterior two pairs of pereiopoda is sometimes filled with a grey mass of firm and leathery texture (*vide*, Pl. XLIX. fig. 3 ♀).

Between the first pair of pleopoda is an elevated ridge, and a prominent point exists in the median line between the second.

The ophthalmi are round and considerably broader than the ophthalmopoda, which carry a rudimentary tubercle on the inner side near the eye.

The first pair of antennæ possesses on the inner side the rudiment of a prosartema covered with long hairs, and on the outer side a stylocerite, in connection with the side of the joint, extending to nearly the extremity of the external angle, which terminates in a sharp point just in advance of it. Between the stylocerite and the inner margin the surface is depressed into a deep hollow, the margins of which are thickly fringed with tolerably long hairs; the second joint is nearly as long as the first, and the third is shorter and carries the short, outer flagellum near the base, and the inner and longer at the apex.

The second pair of antennæ (Pl. L., *c*) carries a large scaphocerite, the outer side of which is strengthened by a slender ridge that terminates in a small sharp tooth somewhat distinct from the rounded, pointed apex.

The anterior three pairs of pereiopoda slightly increase in length posteriorly, and the dactyli are adorned with small fasciculi of hairs at very regular distances.

The first pair of pleopoda is long, slender, and single-branched, and has a small rudimentary petasma attached to the basal joint. The succeeding pairs are biramose, the anterior branch, which is small in the second pair, increases gradually in size posteriorly. The sixth pair, which forms the outer plates of the tail-fan, has the rami long and terminate in a flat, foliaceous, ovate plate, the outer margin of which is strengthened by a rib in the middle that meets the outer margin and forms a tooth somewhat short of the extremity.

The specimen taken at the New Hebrides was rather longer than those from the Philippines, and was glabrous rather than tomentose. The rostrum was also a little longer, stretching beyond the denticulation. In all other respects it corresponded very closely with the typical form.

Aristeus, Duvernoy.

Aristeus, Duvernoy, Ann. d. Sci. Nat., tom. xv. p. 101, 1841.
Funchalia, Johnson, Proc. Zool. Soc. Lond., p. 895, November 28, 1876.

Body laterally compressed. Surface generally rigid, except the inferior portion of the branchial region, where it is soft and membranous.

Carapace laterally and posteriorly produced. Frontal margin produced to a long rostrum.

Pleon having the first somite transversely divided, the anterior division of the dorsal surface underlies the carapace, the posterior being connected with the coxal plate, which anteriorly overrides the postero-lateral margins of the walls of the carapace.

The ophthalmopoda are uni-articulate and support a small tubercle on the inner side.

The first pair of antennæ has the peduncle long; the first joint is but slightly excavate to receive the ophthalmus, it has no prosartema, or only a small process tipped with hairs, but carries a well developed stylocerite on the outer side; the second joint is generally long and subcylindrical, and the third joint is short, and carries two flagella; one, attached near the base of the joint on the outer and upper side, is short, longitudinally flattened, concave below and convex above, while the other, attached to the extremity, is long, slender, and cylindrical.

The second pair of antennæ has the several joints of the peduncle freely articulating with each other and with the metope. The first or coxal joint carries a well-formed phymacerite on the inner side; the second or basisal joint carries a large and broad scaphocerite, which is double-jointed at the base on the under side so as to permit of a downward movement, and is strengthened on the outer side by a rigid margin that terminates anteriorly in a sharp tooth; on the outer side the lateral movement is checked by a small disk-like plate attached to the second joint, and on the inner and upper distal surface is a short, blunt, tooth-like process that is lodged in a depression formed on the under side of the first pair of antennæ, and prevents a too great upward and inward action; the third, fourth, and fifth joints, which are the homotypes of the ischium, meros, and carpos of the true legs, carries at its extremity a long flagellum.

The epistoma is anteriorly produced to a more or less important rostriform point in the median line, and supports posteriorly the cheiloglossa, the labial portion of which overrides the mandibles and meets the metastoma posterior to them; the glossal process passes into the oral cavity and lies anterior to and fills the space between the mandibles.

The mandibles are powerful organs, and have the molar process larger than the incisive, while the synaphipod consists of two narrow joints which do not reach beyond the base of the second pair of antennæ. When the oral appendages are examined *in situ*, the psalisiform blades of the mandibles are seen to overlap each other and resemble "a pair of long sickle-shaped shears, which cross each other from opposite sides

of the mouth," a feature on which Mr. James Yates Johnson founded his genus *Funchalia*.

Posterior to the mandibles lie the two flattened pear-shaped metastomata.

The first pair of siagnopoda is three-branched, the two inner being flat and leaf-like, having the inner margins fringed with short spine-like hairs, and the third or outer articulating at right angles with the preceding.

The second pair of siagnopoda is three-branched; the two inner or basal are biramose, foliaceous, and tipped with short spine-like hairs; the third is short, flat, and pointed; outside this a large mastigobranchial plate is produced anteriorly to a rounded extremity, considerably in advance of the other parts of the appendage, and projects posteriorly, and diagonally outwards, as a valve closing the exit passage from the branchial chamber, the whole being fringed with finely ciliated hairs.

The third pair of siagnopoda consists of a broad, concavo-convex inner plate that is fringed with hairs, a slender three-jointed branch that represents the true limb of the appendage, behind which, and closely associated with it, is a broad membranous plate that at the distal extremity suddenly narrows to a point, and has at its base a broad but short mastigobranchial plate.

The first pair of gnathopoda is subpediform, having the three distal joints reflexed on the inner surface and thickly studded with hairs; the basisal joint carries a long ecphysis, and the coxa supports a mastigobranchial plate bearing a rudimentary podobranchial plume at the base.

The second pair of gnathopoda is pediform, longer than the first, and extended in advance of the frontal margin; it is generally fringed with hairs and terminates in a very straight dactylos capable of being bent to a right angle. The basis carries a long ecphysis, and the coxa supports a mastigobranchial plate that bears a podobranchial plume.

All the pereiopoda are without an ecphysis; the three anterior pairs, which are chelate, support a mastigobranchial plate, carrying a podobranchial plume. The two posterior pairs are not chelate and are less robust, the fourth supports a mastigobranchial plate without a podobranchial plume, and the fifth pair has neither.

The arrangement of the branchial appendages is represented in the following table:—

Pleurobranchiæ,	r	1	1	1	1	1	1
Arthrobranchiæ,	1	2	2	2	2	2	...
Podobranchiæ,	1	1	1	1	1	...	...
Mastigobranchiæ,	1	1	1	1	1	1	...
	h	i	k	l	m	n	o

The ventral surface of the female varies somewhat in the different species, but it appears generally to be provided with a hollow or deep depression, posterior to the pointed thelycum, in which apparently at certain periods a membranous substance is developed or deposited, the use of which is yet to be determined (*vide* Pl. XLIX. figs. 2, 3).

The pleopoda are long and two-branched, the inner branch of the first pair in the male being developed into a membranous petasma, while in the female it is reduced to a rudimentary condition.

The posterior pair is differentiated to form the outer plates of the rhipidura, and are long and ovate; the inner plate is strengthened by a double longitudinal median rib, and the outer by a similar rib that traverses the plate subcentrally, and another that lies along the outer margin, with which the median one coalesces at the margin, a short distance from the distal extremity, to form a lateral tooth, near which is an obsolete diæresis.

Aristeus differs from *Penæus* in many essential points. Those which are external and obvious, and can be readily used for the determination of the genus, are the first pair of antennæ, which have flagella unequal in length and different in form, and possess the notable feature that one springs from near the base of the third joint of the peduncle and the other from its distal extremity; the absence or rudimentary condition of the prosartema; the one-jointed character of the ophthalmopod, which bears on the inner side a small tubercular process which I believe can be demonstrated, in *Benthesicymus*, to be a complementary eye; the altered character of the appendage attached to the mandible, which in this species is comparatively small; certain differences in the form of the oral appendages; and, finally, the structure and arrangement of the branchial plumes.

Geographical Distribution.—This genus consists mostly of deep-water species, which swim freely in the sea, and during the cruise of the Challenger were never captured in less than 255 fathoms of water.

Penæus antennatus, Risso, the type of Duvernoy's genus, was taken in very deep water in the Mediterranean, where it has since been procured by Mr. James Yates Johnson, who obtained his specimens of *Funchalia woodwardi* at Madeira. The form nearest to the type that I have examined is *Aristeus armatus*, which was captured at seven different localities, at depths ranging from 1400 to 2350 fathoms. The average temperature of its habitat was about 36°, the highest being 38°·8, at a depth of 2050 fathoms, off the Philippines. Thus, this species lives in an Arctic temperature, and under the pressure of a column of water more than two miles in depth, between the latitudes of 35° north and 35° south of the Equator.

Running down the eastern coast of South America, in the month of September 1873, the Challenger must have passed through a great multitude of young animals of this genus, varying in size from 4 to 14 mm., all of which bore evidence of belonging to allied species. The specimens corresponded closely excepting in such features as may be dependent upon age.

Aristeus armatus, Spence Bate (Pls. XLV., XLVI.).

Aristeus armatus, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 188, 1881.

Rostrum as long as the carapace, slender, slightly curved upwards, armed with three sharp teeth at the base; dorsal surface smooth, without any carina, anterior margin armed with two antennal teeth, the orbital tooth suppressed. A short longitudinal rib defines the branchial region, which is covered by soft and flexible tissue. The pleon is dorsally armed with three sharp teeth, situated on the third, fourth, and fifth somites, and there is a low carina on the sixth.

Telson narrow, tapering, dorsally flattened and laterally compressed; fringed with hairs and bearing four small spines near the distal extremity.

The ophthalmopoda are club-shaped and rigid.

The first pair of antennæ carries a stylocerite that reaches to the extremity of the second joint, and the third joint carries a very short and flat flagellum, and a second long and slender, being quite as long as the whole animal.

The female corresponds very closely with the male, except in having a greater width between the posterior pereiopoda, and in having the ventral plate broader and flatter.

Habitat.—Station 133, October 11, 1873; lat. 35° 41′ S., long. 20° 55′ W.; South Atlantic Ocean, near Tristan da Cunha; depth, 1900 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·4. One specimen. Trawled.

Length (male), 150 mm. (6 in.), measured from the orbit to the extremity of the telson.

Station 184, August 29, 1874; lat. 12°,8′ S., long. 145° 10′ E.; near Torres Strait; depth, 1400 fathoms; bottom, Globigerina ooze; bottom temperature, 36°. One female and two males. Trawled.

Length—male, 200 mm. (8 in.); female, about 12 mm. shorter.

Station 213, February 8, 1875; lat. 5° 47′ N., long. 124° 1′ E.; near the Philippines; depth, 2050 fathoms; bottom, blue mud; bottom temperature, 38°·8. One specimen. Trawled.

Length (male), 70 mm. (2·75 in.).

Station 237, June 17, 1875; lat. 34° 37′ N., long. 140° 32′ E.; off Japan; depth, 1875 fathoms; bottom, blue mud; bottom temperature, 35°·3. One female. Trawled.

Station 246, July 2, 1875; lat. 36° 10′ N., long. 178° 0′ E.; Mid-Pacific; depth, 2050 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·1. One specimen. Trawled.

Length (male), 177 mm. (7 in.).

Station 276, September 16, 1875; lat. 13° 28′ S., long. 149° 30′ W.; the Low Archipelago; depth, 2350 fathoms; bottom, red clay; bottom temperature, 35°·1. One specimen; female.

Station 323, February 28, 1876; lat. 35° 39′ S., long. 50° 47′ W.; east of Buenos Ayres; depth, 1900 fathoms; bottom, blue mud; bottom temperature, 33°·1 F. One specimen. Trawled.

Length (male), 164 mm. (6·5 in.).

Three fine specimens of this species, two males and a female, were taken in the middle of the Southern Indian Ocean. One, a female, was taken off the south coast of Japan; it was not so large nor so fine a specimen as the preceding. A small but well-formed female was taken near the Philippine Islands, and another east of the Torres Strait; a fine male specimen was trawled in mid-ocean in the North Pacific; one rather small female was taken near the Low Islands in the Pacific Ocean; a well-developed male was taken off Buenos Ayres; and a similar one not far from the island of Tristan da Cunha, in the South Atlantic Ocean, at an average depth of nearly two miles and a half.

In this species the carina from the dorsal crest is continued but a little distance behind the posterior tooth, where it becomes lost in the smooth surface of the carapace. There is no trace of the cervical suture. The rostrum is as far in advance of the orbital margin as the length of the carapace, measured from the same point. There is a small dorsal crest above the orbit crowned with three teeth, of which the posterior is the smallest. The orbit is imperfectly defined by a small prominence, chiefly visible in front of and below the margin of the carapace, and immediately outside of it is the first antennal tooth, which is small, being elevated rather than prominent. From this part of the orbital margin a ridge runs for a short distance and then divides, one above the other, ending in the hepatic groove. Beyond this is the second antennal tooth, both elevated and prominent, and continuous posteriorly with a ridge that extends to half the length of the carapace and forms the second antennal ridge. Below the second antennal ridge the middle branchial ridge runs horizontally, and parallel with the lower margin, from the anterior to the posterior border of the carapace, and becomes confluent with the latter, which is elevated into a marginal ridge. Below the median branchial ridge the walls of the carapace are soft and flexible.

The first somite of the pleon is long, and divided by a deep transverse groove into two parts; the anterior is convex and smooth, the posterior is shorter than the anterior and continuous with the coxal marginal plates.

The second somite has also a deep transverse sulcus, but the anterior division is shorter than the posterior, and, like the preceding, has the lower margin of the coxal plate slightly truncated, having the appearance of being cut straight, so that the lower margins of the coxal plates form a continuous line from the anterior to the posterior extremity of the pleon.

The third somite has a less conspicuous transverse groove nearer the anterior margin than in the preceding, and the posterior margin is produced into a strong, sharp,

laterally compressed tooth. The next two are similar but have no transverse groove; the dorsal ridge becomes slightly carinated, and this carina extends to the extremity of the sixth somite, but is not produced to a tooth.

The telson is long and laterally compressed, terminating in a sharp-pointed extremity, and reaching as far as the distal extremity of the inner branch of the tail-fan; it is smooth and slightly flattened on the dorsal surface, depressed at the margins, which are armed with four, unequally distant, small, movable spines, the anterior of which is near the middle of the margin.

The ophthalmopod is flattened and has the rudiment of a tubercle on the inner margin. The ophthalmus is orbicular and a little broader than the diameter of the stalk.

The first pair of antennæ has the peduncle about half the length of the rostrum. The first joint is a little longer than the ophthalmopod, and is flattened, but not deeply excavated, for its reception, and has only the rudiment of a prosartema on the inner side, while on the outer the stylocerite longitudinally overlaps the margin and projects beyond the anterior outer angle as far forwards as the distal extremity of the second joint, which is subcylindrical, and rather more than half the length of the first; the third is short and carries the smaller flagellum about midway between the base and the distal extremity, where the longer flagellum articulates; the shorter flagellum is about half the length of the peduncle, while the longer one is equal to the entire length of the animal.

The second pair of antennæ has all the five joints of the peduncle freely articulating one with the other; the coxal joint carries on the inner side a prominent phymacerite, the membranous surface of which is directed obliquely forwards and inwards. The second carries, on the upper and outer side, a large foliaceous scaphocerite, strengthened on the outer margin by a longitudinal ridge that terminates in a sharp tooth one-fifth from the distal extremity, and supporting, on the inner and upper margin, a small hook-like process, which, when at rest, is lodged in a hollow on the under surface of the first joint of the first antenna, just within the rigid base of the stylocerite; the third joint articulates longitudinally with the second on the inner side, the fourth joint is short, and the fifth reaches to nearly half the length of the scaphocerite, and terminates in a long and slender flagellum that is about once and a half as long as the animal. The epistoma is narrow, and projects in the form of a small rostrum; the cheiloglossa is prominent, triangulate, rigid anteriorly, and forming on each side posteriorly a large tubercular process that corresponds with, and occupies, the depression between the psalisiform and molar processes.

The mandibles are strong and powerful, and carry a two-jointed synaphipod, the first joint of which is long and narrow and the second short and triangulate, and both are thickly studded with hairs. The psalistoma is smooth, except for a single small denticle near the centre; it is sharp-pointed at the anterior angle, and overlaps its fellow.

The metastoma is double, somewhat pear-shaped, and flattened against the posterior walls of the mandibles.

The first pair of siagnopoda is three-branched; the first two branches are flat, strong, and fringed at the inner margin with short hairs and strong spines; the third is short, terminating in an ovate distal extremity that carries several long and simple hairs, while the outer margin is fringed with plumose cilia, and at the base there is a fasciculus of ciliated hairs.

The second pair of siagnopoda is three-branched, two of the branches are flattened, subfoliaceous and biramose, and each is tipped with short stiff hairs; the third is short, flat and pointed, and attached to the coxal joint is a large mastigobranchial plate that projects anteriorly beyond the extremity of the limbs, and posteriorly, while short, is broadly expanded.

The third pair of siagnopoda is five-branched; the coxa is short, studded upon the inner side with short stiff hairs, and carries externally a large, broad, mastigobranchial plate; the second or basis is short and carries on the inner side a broad, rigid, slightly flexed plate that is thickly fringed with stiff hairs, and on the outer side a long and flat ecphysis; the three next joints articulate terminally, the last being ovate, and all are fringed with numerous, long, ciliated hairs.

The first pair of gnathopoda is subpediform; the coxa carries a well-developed mastigobranchia and podobranchial plume; the basis is very short and carries a small ecphysis; the ischium is equally short, and closely associated with the basis; the meros is long, stout on the outer side and thin on the inner, where it is thickly fringed with hairs; the carpos is triangulate, stout, and thickly covered with hair; the propodos and dactylos are terminally articulated, and lie reflexed against the meros; they are widest at the carpal joint, and taper gradually to the unguiculate extremity, which is armed with three strong teeth, of which the most robust is at the extremity.

The second pair of gnathopoda is long and pediform; the coxa carries a mastigobranchia with a podobranchial plume attached; the basis carries a very small and slender ecphysis, the ischium is long and narrow; the meros is half the length of the ischium, narrow and subcylindrical; the carpos and propodos are equal in length to the ischium, but more slender and cylindrical, and the dactylos is slender, tapering, and slightly shorter than the propodos, and has the under surface thickly covered with hairs.

The first three pairs of pereiopoda are subequal, but not large, nor differing from those of *Penæus* proper; they each support well-developed mastigobranchial plates and well-developed plumes. The podobranchiæ and the arthrobranchiæ are the largest, the pleurobranchiæ being small but not rudimentary.

The posterior two pairs are long and slender, reaching as far forwards as the extremity of the smaller flagellum of the first pair of antennæ.

In the female the oviducts open on a flattened tubercular process, situated on the

inner and posterior side of the third pair of pereiopoda, and protected by hairs around the orifice, exposed when the leg is directed backwards, and hidden when it is thrown forwards, being protected by the anterior margin of the thelycum, which lies between the penultimate pair as a flattened plate, which is pointed forwards. A similar plate, reversed in form, with a carinated ridge traversing the median line, stands between the ultimate pair. It is absent or reduced to a minimum in the male, its place being occupied by the enlargement of the coxal joints (Pl. XLV. fig. 2) of the posterior pair of pereiopoda and the protuberance that carries the vas deferens, the slit-like aperture for which is narrow. These organs almost meet in the centre, and a narrow tooth-like process projects forwards from them on each side, and rests against the coxa of the preceding legs.

In the male the first pair of pleopoda (*p*) has the basisal joint transversely triangulate; the inner margin near the base carries a small and rigid process, from near the root of which a large, foliaceous organ, the petasma, arises and spreads itself out until it reaches its corresponding fellow, to which it is linked, in the adult, by a series of small cincinnuli, thus forming a veil or curtain across the ventral surface. This pair of pleopoda carries a long, two-jointed branch, the first joint of which is simple, and the second multiarticulate.

In the female these pleopoda are similar, but the inner branch, which forms the petasma in the male, is reduced to a rudimentary condition. Between these pleopoda, in the median line, is a long and laterally compressed tooth-like process.

The second pair of pleopoda is biramose, the anterior branch being small, almost rudimentary, in both sexes, but in the male there springs from its base a two-jointed complementary appendage that is wide, flattened, and capable of being compressed closely against the anterior surface of the posterior branch. The third and succeeding pairs of pleopoda have the anterior or smaller branch gradually increasing in size until in the fifth pair it is subequal to the posterior branch.

The sixth pair forms the outer branches of the tail-fan; the inner branch is markedly ovate, strengthened in the median line by two longitudinal ridges, one of which is continuous from near the apex to the articular process, but the inner, or that nearer the telson, diverges and curves towards the margin near the root of the telson. The outer branch is also ovate, but much longer than the inner. It is strengthened by three longitudinal ridges, one along the outer margin, terminating nearly opposite the extremity of the telson; the second on the outer side of the median line, with which it runs parallel until towards the extremity, where it curves outwards and unites with the outer ridge to make a strong, sharp tooth; the third is in the median line and terminates at the extremity of an imperfect diæresis; between this ridge and the second is a deep sulcus. The rest of the plate is smooth, and its inner and distal margins as well as those of the inner or smaller plate, are fringed with ciliated hairs.

Aristeus rostridentatus, Spence Bate (Pl. LI.).

Aristeus rostridentatus, Sp. B., *loc. cit.*, p. 189.

Carapace smooth. Rostrum markedly elevated anteriorly, as long as the carapace. Dorsal surface crested above the frontal region, serrate with distantly placed teeth from the posterior portion of the crest to the extremity of the rostrum. Lower margin smooth. Frontal margin of the carapace armed with a first and a second antennal tooth; a sharp tooth on the hepatic region.

The pleon is slightly compressed posterior to the third somite. The third, fourth, fifth, and sixth somites are slightly carinated, and have the posterior margin produced to a small tooth in the median dorsal line. The telson is long, and tapers to a styliform point; the dorsal surface is slightly grooved; the sides are depressed, and the margins are fringed with a thick row of hairs and four small spines.

The ophthalmopod is short and small, the ophthalmus large and round. The first pair of antennæ has the peduncle half the length of the rostrum; the first joint is a little longer than the ophthalmopod and supports a stylocerite that reaches beyond the eye, but does not extend to the extremity of the first joint. The second joint is rather shorter than the first; it is cylindrical and hirsute. The third joint is nearly as long as the first, and carries the smaller flagellum near the base and the longer at the apex; the former is not longer than the joint that supports it, whereas the latter is longer than the animal.

The second pair of antennæ is about four times the length of the animal, and has a scaphocerite extending as far as the extremity of the peduncle of the first pair.

The first pair of gnathopoda is short, and carries an ecphysis much longer than itself.

The second is long, and carries an ecphysis that is about one-third its length.

The pereiopoda approximate to each other ventrally, and a small vertical plate projects between the coxæ of the fourth pair, which are hirsute. A prominent and sharp tooth stands between the pleopoda, which are of only generic value.

Length, largest about 131 mm. (5·25 in.), smallest 38 mm. (1·5 in.)

Habitat.—Station 173, July 24, 1874; lat. 19° 9′ 35″ S., long 179° 41′ 50″ E.; near the Fiji Islands; depth, 315 fathoms; bottom, coral mud. Three specimens; females. Dredged.

This species bears a general resemblance to *Aristeus armatus*, and might on a hasty examination be taken for a variety of that species, but a detailed examination shows that there are some very important differences that separate them widely. The rostrum, continuing the anterior slope of the carapace, is first depressed, and then it somewhat suddenly ascends. It carries on the dorsal surface numerous distantly situated small teeth. These, from their number and position, furnish a ready means of diagnosis, but it is

not impossible that they may be sometimes reduced in number and become less conspicuous in various specimens, and this would render the resemblance between this species and *Aristeus armatus* still greater. The carapace as well as the lateral walls of the pleon are tomentose generally, which is a character of considerable importance, but the pile is likely in old animals to be much rubbed off and therefore less noticeable. The shortness and small diameter of the eye-stalk, and the comparative largeness of the eye itself, which rests partially within a hollow thickly fringed with rather long hairs, is another conspicuous feature. The first pair of antennæ has the stylocerite waved, strong, and scarcely reaching to the extremity of the first joint, which is armed at the outer angle with a sharp tooth; the second joint is a little shorter than the first, is subcylindrical and covered all over with hairs; the third joint supports a flagellum rather shorter than in most species and attached near the base, while the other situated at the extremity is longer. The latter was broken off in our specimen at a length about equal to that of the entire animal, but, from comparison with other species, it was probably longer.

The second pair is remarkable for the great length of the flagellum, about four times that of the entire animal, and carries at its base a broad scaphocerite that is about as long as the peduncle of the first pair, extends inwards and dips between the antennæ, and partially encloses the last joints of the peduncle, which are rather long, reaching to about two-thirds of the scaphocerite. The ancecerite or hook-like process is reduced to a small rigid tubercle, but the phymacerite is prominent and horse-shoe-shaped.

The epistoma projects forwards as a rounded pilose prominence, from which the cheiloglossa projects downwards and overlaps the anterior margin of the mandibles, the glossal portion filling the space between them. The mandible (*d*) is a strong and powerful organ, and differs from that of the type only in the form of the synaphipod being more pronounced, having the second joint nearly as long as the first, and carrying a strong projecting process near the base; both joints are thickly covered with long and stiff hairs.

The metastoma is double and pear-shaped, overlaps the mandibles posteriorly and reaches to the anterior lip.

The first pair of siagnopoda has the first branch shorter and more quadrate, and the second longer and more spinose.

The succeeding pairs are very similar to those of *Aristeus armatus*.

The first pair of gnathopoda is subpediform, very hirsute at the margins, and carries an extremely long branch attached to the basisal joint; the first joint of this branch is very short and simple, the second is multiarticulate and fringed with numerous long fine hairs.

The second pair of gnathopoda is long, slender, and fringed with long stiff hairs, each of which stands on its own protuberance on the inner and lower margin; the dactylos articulates with the propodos so as to attain a right angle only, at which degree two bunches of small curved spinules on the opposed sides, one on the propodos and the

other on the dactylos, come into contact, and acquire a prehensile power; it likewise carries a basisal branch, which is very short, being about half the length of the meros or third joint; the first joint of the branch is almost rudimentarily short, and the second is multiarticulate and free from conspicuous hairs.

The first pair of pereiopoda is chelate and armed with long stiff hairs, and differs from the second and third in being shorter and more hirsute, and in having, as in the second pair of gnathopoda, two fasciculi of spinous or serrate hairs near the carpal articulation, one bunch being in a depression on the anterior extremity of the flexor side of the carpos, while the other corresponds with it on the posterior extremity of the propodos. This arrangement appears to give prehensile power by the bending of the propodos against the carpos.

The posterior two pairs of pereiopoda are long and slender; the posterior most so.

The ventral surface of the pereion (1″) is much hidden by the long hairs attached to the coxæ of the legs; the oviducts on the third pair nearly meet in the median line, posterior to which there is a small thelycum and ventral plate much like those of *Hemipenæus tomentosus*.

The first pair of pleopoda is long and single-branched, the inner branch being rudimentary. The others gradually decrease in length; they are biramose, and the smaller branch increases posteriorly, until in the fifth pair the two branches are subequal.

The telson differs from that in the other species of the genus in being fringed with a thick and closely packed row of hairs, intermingled with four small spines on each side. The dorsal surface is flat and slightly grooved, and the sides, deflecting, become suddenly depressed, making on each side an angular longitudinal ridge from the base to the distal extremity.

The branchial arrangement is the same as in the typical species. The oral appendages, and those that belong to the anterior portion of the pereion, are remarkable for the length and rigid character of the hairs that fringe them, whereas the posterior pairs of pereiopoda, as well as the pleopoda, are as remarkable for being free from hairs.

Hepomadus, Spence Bate.

Hepomadus, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 189, 1881.

Supra-frontal margin of the carapace produced to a rostrum. Latero-frontal margin produced to a tooth that corresponds with the outer margin of the first pair of antennæ, another that corresponds with the second pair of antennæ, and a third over the hepatic region. The pleon is laterally compressed.

The ophthalmopoda stand on a movable somite; they are compressed and carry a small tubercle near the base on the inner margin, and the ophthalmus is scarcely of larger diameter than the peduncle.

The first pair of antennæ stands on a movable somite and has the first joint dorsally excavated to receive the ophthalmopod; it carries a long and pointed stylocerite on the outer margin, and the rudiment of a prosartema, in the form of a tubercle tufted with long hairs, on the inner side; the third joint terminates in two unequal flagella situated remotely from each other, the upper one, arising from the base, is half the length of the peduncle, whereas the lower, which is more slender, is probably as long as the animal, or longer.

The second pair of antennæ carries a broad scaphocerite, as long as the peduncle of the first pair, strengthened by a pointed tooth on the outer margin, and by one on the second joint of the peduncle.

The mandible has a lunate psalisiform margin and a broad molar tubercle, and carries a two-jointed synaphipod, the terminal joint of which is laterally excavate.

The third pair of siagnopoda is four-branched; the inner branch is broad, foliaceous and hirsute, the second is three-jointed; the next is foliaceous, narrow, and terminates in a slender point, while the outer is a bifid membranous plate.

The branchiæ are arranged as in the following table:—

Pleurobranchiæ,	1	1	1	1	1	1	1
Arthrobranchiæ,	1	2	2	2	2	2	...
Podobranchiæ,	1	1	1	1	...	...	...
Mastigobranchiæ,	1	1	1	1	1	...	...
	h	i	k	l	m	n	o

The rostrum in the single Challenger specimen is broken off, but I am inclined to believe that it corresponds in form to that in *Aristeus*. The outer antennal tooth is larger than in that genus, and there is also a hepatic tooth, which the species of *Aristeus* do not possess.

The ophthalmopod corresponds in form more to that in the genus *Benthesicymus* than in *Aristeus*, whereas the antennæ correspond rather to those of the latter genus.

The mandibles differ in having a larger molar tubercle, and in having the incisive margin simply curved, with a sharp tooth at either extremity, while in *Aristeus* there is a strong tooth in the centre also.

The first pair of oral appendages has the outer branch thin, foliaceous, and produced to a slender point, and in this it corresponds with *Benthesicymus* and differs from *Aristeus*.

The branchiæ differ from both genera in the number of the plumes; in ultimate structure they correspond with those in *Hemipenæus tomentosus* more than with those in either *Aristeus armatus* or *Benthesicymus crenatus*, the types of their respective genera.

Hepomadus glacialis, Spence Bate (Pl. LII.).

Hepomadus glacialis, Sp. B., *loc. cit.*, p. 190.

Rostrum broken off short; the base of a small tooth exists on the dorsal crest just behind the orbital margin. Dorsal surface of the carapace compressed, elevated, and surmounted by a small carina that commences just anterior to the cardiac region and continues to the rostral projection. The inner antennal tooth is well defined, but not so large nor so conspicuous as the outer antennal tooth. The hepatic tooth is large, sharp, and distinct.

The pleon is compressed, and has the third somite posteriorly produced to a well-defined sharp tooth that reaches nearly to half the length of the fourth somite, which is posteriorly produced dorsally to a small tooth, as is also the fifth somite, where it is still smaller. The sixth also carries a small terminal point. The telson is broken near the distal extremity.

The ophthalmopoda project from the lateral extremities of a conspicuous somite and are uniarticulate, slender, flattened dorsally, and have an ophthalmus that is not much broader than the peduncle.

The first pair of antennæ has the stylocerite reaching to the extremity of the first joint and the prosartema thickly tufted with hairs. The upper flagellum is short, about the length of the two last joints of the peduncle; the lower is slender and was probably very long, but is broken off at the length of the carapace.

The second pair is also damaged, the peduncle alone being preserved; the scaphocerite which is broad and foliaceous is strengthened by a ridge on the outer side that terminates in a small sharp tooth; the flagellum is broken off short; a sharp, strong tooth arms the outer side of the second joint of the peduncle, and the first joint or coxa carries a phymacerite on the inner side, just in front of the epistoma, which is produced to a point anteriorly and posteriorly supports the broad and movable cheiloglossa.

The mandible (*d*) has a broad, curved, lunate, incisive margin, and a large, smooth, molar protuberance; the synaphipod is two-jointed, having the second joint shorter than the first and excavated on the inner side.

The two pairs of oral appendages that succeed the mandibles are thin, foliaceous, and resemble those of *Aristeus armatus*, while the next (*g*) differs from that in *Aristeus* in having the outer branch long, and terminating in a slender extremity, and in this respect it resembles more nearly the same appendage in *Benthesicymus crenatus*.

The first pair of gnathopoda is short, subpediform, and consists of six joints. The coxa carries a short and broad mastigobranchia, to which a podobranchial plume is attached; the basis supports a long, slender, two-jointed ecphysis, that is as long as the gnathopod, the first joint being very short and the second multiarticulate: the ischium appears to be confluent with the basis (thus making one joint), and only definable by a

transverse ridge and the marginal lobes which are tufted with hair; the meros is long and broad, stout on the outer side and thin on the inner, which is fringed with hairs; the carpos is short, curved, and stouter at the propodal extremity than at the meral; the propodos is short, being not longer than the carpos, and matted on the inner side with many hairs; the dactylos is stout and blunt-pointed, as long as the propodos, and matted with hairs on the inner side.

The second pair of gnathopoda is seven-jointed, long and slender. The coxa carries a mastigobranchial plate that supports a podobranchial plume, and the basis supports a two-jointed ecphysis that is about half the length of the limb; it is two-jointed, one joint being small and the second long and multiarticulate. The ischium is long and narrow, the margins parallel, the inner margin thin and fringed with hair, the outer robust and smooth; the meros is about half the length of the ischium and a little shorter than the carpos, which is rather longer than the propodos and terminates in a straight and pointed dactylos that is half its length, and is movable to the extent of a right angle; it is not armed with impinging spinules at the base, but is excavated and smooth, all the joints being fringed on the inner side with fine hairs.

The two anterior pairs of pereiopoda are similarly formed, the second being longer than the first; all the joints, including the basis and coxa, are smooth, the latter carries a mastigobranchia that supports a podobranchial plume, and the basis carries a small, rudimentary ecphysis; the carpos is long and slender, equalling in length the meros and ischium together. The propodos is short, but the pollex is long and slender, equalling in length and resembling in form the long, tapering dactylos, the margins of which are sparsely fringed with a few, short, bristle-like hairs. The third resembles the two preceding pairs in form and general proportions, but differs in being longer and in having on the coxa a large, hirsute protuberance, that is cupped on the outer side, and carries on the inner the foramen opening into the oviducts. The fourth and fifth pairs are long, slender, and simple, terminating in a styliform dactylos; they both carry at the inner side of the coxa a similarly formed tubercle to that of the third pair, and on the ventral surface of the pereion, between the penultimate pair, is a large, anteriorly pointed and posteriorly truncated thelycum (1″); the oviducts lie just beneath the anterior extremity, which covers them until they are exposed by the outward and backward movement of the legs.

The pleopoda are long and slender, the first pair single, and having the second branch in a rudimentary form attached to the basal joint near the middle of the inner surface. The inner branches are throughout smaller than the outer; the outer gradually decrease, while the inner increase, posteriorly.

The plates of the rhipidura are long, tapering, strengthened by longitudinal ridges, and fringed with hairs.

The telson is broken off near the extremity.

Length (female), 196 mm. (7·20 in.).

Habitat.—Station 237, June 17, 1875; lat. 34° 37′ N., long. 140° 32′ E.; near Yokohama; depth, 1875 fathoms; bottom, blue mud; bottom temperature, 35°·3. One specimen; female.

Hepomadus inermis, Spence Bate.

Hepomadus inermis, Sp. B., *loc. cit.*, p. 190.

Dorsal surface unarmed. Pleon smooth.

Telson half the length of the outer plate of the rhipidura.

Length, 100 mm. (4 in.).

Habitat.—Station 289, October 23, 1875; lat. 39° 41′ S., long. 131° 23′ W.; South Pacific; depth, 2550 fathoms; bottom, red clay; bottom temperature, 34°·8.

The specimen taken at this station is that which I have previously named *Hepomadus inermis*, because there was no tooth on the dorsal crest or pleon. It is in too imperfect a condition to fully describe its specific characters; the absence of the dorsal armature on the carapace may probably be due to the fracture of the rostrum, but the absence of the large tooth on the third somite of the pleon demonstrates it to be specifically distinct from *Hepomadus glacialis*.

Peteinura,[1] n. gen.

Carapace about one-third the length of the animal, deeper posteriorly than anteriorly, and produced forwards to a long and slender rostrum; armed with a tooth near the outer canthus of the orbit, another posterior to the second antennæ, and others corresponding with the upper margin of the branchial chamber.

The five anterior somites of the pleon are subequal, the sixth is about the length of the four preceding but not half the depth, and carries a pair of pleopoda that has the rami very unequal, the outer being nearly as large as the animal, the other small and rudimentary.

The telson tapers to a sharp point.

The ophthalmopoda are uniarticulate and pyriform.

The first pair of antennæ has a three-jointed peduncle and terminates in two short flagella.

The second pair of antennæ carries a long scaphocerite and a slender flagellum.

The second pair of gnathopoda is pediform, and terminates in a styliform dactylos.

The first, second, and third (?) pairs of pereiopoda are imperfectly chelate, the posterior two are simple.

[1] πετεινός, flying, and οὐρά, tail.

The first pair of pleopoda is not determinable; the four following are short and biramose.

The branchiæ have not been examined because the specimen is unique and of exceptional character.

I believe the specimen to be an immature form, but in its general appearance it approximates more to that of *Aristeus* than to any other, but when other specimens have been taken and an opportunity has been afforded for an examination of the branchiæ, we shall be in a better position to determine with confidence its natural position in the order.

Peteinura gubernata, n. sp. (Pl. LIII.).

Viewed laterally, the carapace triangulate, posteriorly deep, anteriorly narrow. Rostrum, though broken off at the extremity, is much longer than the carapace, probably nearly as long as the animal, and is spinous or denticulated above, below, and along the sides from base to tip, the smaller teeth being towards the apex and the larger at the base on the upper surface; the posterior two are articulated spines, while all the others appear to be rigid points. One large spine-like tooth stands above the orbital margin, one further in, on the antennal region; six are implanted on the branchial region, three anterior and superior, and three inferior and posterior, of which the posterior is by far the longest.

The pleon has the first five somites subequal in length, the three posterior ones decreasing a little in length and depth. The dorsal surface of each is surmounted with a long spine-like tooth; the posterior margin is furnished laterally with a small tooth halfway between the dorsal and lateral margins; the lateral margin is posteriorly produced to a small point, and the ventral surface in the median line is produced to a short strong tooth, directed infero-posteriorly. The sixth somite is long, narrow and subcylindrical; it is about as long as the four preceding somites combined; the postero-dorsal margin is produced to a large spiniform tooth, broad at the base and acute at the point; at each side of the base is a strong but slender tooth, and the postero-ventral surface is armed with a strong and slender tooth that projects posteriorly between the basal joints of the rhipidura.

The telson is nearly as long as the sixth somite and terminates in a sharp point.

The ophthalmopoda are short and pyriform, the ophthalmus being much broader than the stalk, and the whole organ gradually tapering to the base.

The first pair of antennæ has a three-jointed peduncle, the length of which from the extremity to the base is about half the length of the carapace. The first joint reaches beyond the extremity of the ophthalmopod and is armed on the outer surface near the base with a sharp tooth (stylocerite). The second joint is about one-third the length of

the first, and the third is half the length of the second and supports at its extremity two flagella. The inner branch is the primary and is multiarticulate; the articuli, which are very slender and long at the extremity, become gradually shorter as they approach the base, where, instead of continuing extremely narrow, they coalesce into one bulb-like mass, from which a number of long and slender membranous hair-like organs spring. The outer branch is more slender; if it is formed of more than one articulation, as presumably it is, the divisions between them are not visible.

The oral appendages have not been examined.

The second pair of gnathopoda consists probably of seven joints. The basis and coxa are short and not visible in the mounted specimen; the ischium is moderately long and free from spines; the meros is smooth on the upper margin and armed with five smooth articulated spines on the lower margin; the carpos is longer than the meros, furnished on the upper surface submarginally with several minute spines, and on the lower with seven or eight long and slender spines that stand upon and articulate with a series of prominences like truncated points. The propodos is shorter than the carpos, somewhat irregular in form, the upper surface being waved or bent and the lower strongly tuberculated, each tubercle supporting a strong sharp spine; the upper margin armed with a few stiff hairs or spines which are not elevated on tubercles. The dactylos is half the length of the propodos; it is narrower than the preceding joints, bearing on the upper margin two small, spine-like hairs, and three on the lower, and tipped at the extremity with a long, straight, articulated spine.

The first pair of pereiopoda has the lower margin of the ischium fringed with eight or nine strong hairs, springing from small prominences that gradually increase in size anteriorly, and the upper margin with a row of small spines or short hairs which stand on very small eminences, more apparent anteriorly than posteriorly; the meros is half the length of the ischium, and is armed above and below with long spines that stand on well-defined prominences, more especially on the lower margin, where they are also longer than on the upper. The carpos is shorter than the meros, without spines on the upper margin and with only two large and strong ones on the lower. The propodos is short, a little shorter than the carpos; it is armed on the upper surface with four spines standing on tubercles, and with one spine at the anterior margin on a prominent tubercle; immediately behind which is a prominent, smooth-tipped tubercle, that is developed as a pollex, and against which probably when fully developed the dactylos has the power of being flexed. The dactylos is short, narrow, and feeble, and tipped with a long and slender articulated spine.

The second pair of pereiopoda I have not fully made out, but the carpos is long, cylindrical, and furnished with a few slender hairs on the upper side near the meral extremity, and anteriorly smooth and free from hairs. The propodos is shorter than the carpos and is at the lower distal extremity produced to a blunt

polliciform process, and armed above it with a long straight spine. The dactylos is less than half the length of the propodos, obtuse at the apex and carrying a long, slender, hair-like spine. The other pereiopoda resemble the preceding, except that I could not determine any evidence of a rudimentary chela, and that they appear to lose the spinous character as they proceed posteriorly. The pleopoda, with the exception of the first, which I have not been able to determine, are short and biramose. The posterior pair which helps to form the rhipidura is remarkable, and, I believe, unique; the basal joint is short and is furnished with a tooth on the anterior distal angle, and at the extremity with two branches, one of which is very long, large, broad, and foliaceous; it is narrow at each extremity and wide in the middle, the distal end terminating truncately, and armed at each angle with a small tooth or spine; smaller points or teeth fringe the margins from the apex to the base, and at the base the lateral margins are curled over towards the plate, thus giving strength to the basal portion of the appendage. The inner plate is small, flat, rudimentary, and tipped with a few small hairs.

Length, 25 mm. (1 in.).

Habitat.—Atlantic Ocean; surface (captured at night).

Benthesicymus,[1] Spence Bate.

Benthesicymus, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 190, 1881.

Body smooth. Tissue submembranous. Carapace anteriorly produced on the dorsal surface to a short rostrum, laterally compressed and elevated to a crest. Cervical fossa deeply marked; a strong calcified ridge separates the lateral cardiac from the branchial region.

Posterior somites of the pleon laterally compressed and shorter than the rami of the rhipidura. The telson is narrow, pointed, laterally compressed.

Ophthalmopoda transversely compressed in their whole length, single-jointed; furnished on the inner side with an ocular tubercle. Ophthalmus not broader than the peduncle.

First pair of antennæ has the first joint of the peduncle excavated to receive the ophthalmopod, armed on the outer margin with a stout stylocerite, but without a prosartema on the inner; the two succeeding joints are short, and the terminal one supports two long flagella articulating at the extremity, the upper and outer being more robust than the inner and lower.

The second pair of antennæ supports on the inner side of the first or coxal joint a well-developed phymacerite; the second joint carries a large, broad, and foliaceous scaphocerite, strengthened on the outer margin by a rigid rib that terminates in a small tooth or point; the third joint supports on the inner distal side a small, hook-like,

[1] Βενθεσίκυμος, an inhabitant of deep water.

calcified process (ancecerite) that is lodged in a depression on the under surface of the first antennæ; the fifth joint of the peduncle coalesces rather than articulates with the fourth, and supports a long and slender flagellum.

The epistoma is anteriorly produced to a rostriform point, and the cheiloglossa has the labial portion short and divided into two lobular processes that do not cover the mandibles; the glossal division is reduced in size and unimportant.

The mandibles are large, powerful, and carry a two-jointed foliaceous synaphipod, the first joint being broad, and the second narrow and pointed; the right mandible has a more obtuse cutting edge than the left, and they overlap each other instead of impinging at their margins. The metastoma consists of two membranous, subfoliaceous, rounded plates.

The rest of the oral appendages correspond in form with those of *Aristeus* rather than with those of *Penæus*.

The first pair of gnathopoda is subpediform and carries a long basecphysis, the three terminal joints being permanently flexed upon the preceding one, and the ultimate terminates in two or three apical teeth.

The second pair of gnathopoda is pediform, carries a long basecphysis, and terminates in a sharp-pointed dactylos. Both gnathopoda support well-formed mastigobranchial plates, which are furnished with large podobranchial plumes.

The three anterior pairs of pereiopoda are chelate, slender, and increase in length posteriorly; the two succeeding ones are still longer, more slender, and terminate in simple dactyli. Each pereiopod carries a small basecphysis that becomes gradually less important posteriorly until it becomes rudimentary. The coxa, from the first gnathopod to the penultimate pair of pereiopoda, supports a large and well-formed mastigobranchial plate that increases in length and size, and each, except the posterior, supports a well-developed podobranchial plume that also increases posteriorly. The general arrangement of the branchiæ is shown in the following table :—

Pleurobranchiæ,	...	1	1	1	1	1	1
Arthrobranchiæ,	2	2	2	2	2	2	...
Podobranchiæ,	1	1	1	1	1	...	...
Mastigobranchiæ,	1	1	1	1	1	1	...
	h	i	k	l	m	n	o

The pleopoda are extremely long, and all, except the first pair, are biramose in both sexes. In the male the basal joint of the first pair carries a membranous leaf-like petasma, which in the female is reduced to a rudimentary condition, and the sixth pair is modified to form the outer plates of the rhipidura, which are long, ovate, and lanceolate at the extremity. The outer plate is strengthened by a double marginal rib, terminating in a sub-apical tooth, that coincides with the traces of an obsolete diæresis.

This genus differs considerably from *Penæus* in the consistency of the general surface, which is soft and yielding, and more like flexible membrane than the shell of a crustaceous animal. The only rigid parts are the appendages and the caudal extremity.

The species of this genus may generally be recognised by the character of the rostral crest, which is shorter than in either *Penæus* or *Aristeus*. The form of the ophthalmopod also differs; it is flattened and two-jointed in *Penæus*, cylindrical and single-jointed in *Aristeus*, and single-jointed and flattened in *Benthesicymus*, where it also carries a tubercle similar to that in *Aristeus* and other genera. Owing to the semitransparent character of the superficial tissue in *Benthesicymus* I have been able to determine that this tubercle is a rudimentary, or rather a complementary, eye, a branch of the optic nerve leading directly to it from a ganglion situated within the base of the ophthalmopod.

The first pair of antennæ approximates to that of *Penæus* in its general form and in the arrangement of the flagella, but the prosartema is wanting, and in this respect it approaches *Aristeus*, to which genus also it seems allied by the form of the second pair of antennæ and the oral appendages.

The three anterior pairs of pereiopoda are moderately robust, and the two posterior pairs are long and feeble, and probably of little use as organs of active locomotion.

The pleopoda are long and powerful organs and resemble those of *Aristeus* rather than of *Penæus*, and the rhipidura is well developed and comparatively large.

Geographical Distribution.—The genus evidently consists of species of natatorial habit, chiefly inhabiting the depths of the sea, although its closely allied congener, *Gennadas*, has been captured in towing nets within 500 fathoms of the surface.

Females of *Benthesicymus crenatus* were taken in the Pacific Ocean near the Marquesas Islands and the Low Archipelago, at a depth of about three miles. Female specimens of *Benthesicymus altus* were obtained near Torres Strait at little under two miles from the surface; but those that I believe to be the males of this species were taken in the Pacific in about 500 fathoms, off the Kermadec Islands; north of New Zealand; south of the Celebes, and off the southern shores of Japan. A male specimen of a species differing from the preceding in minute details, that I have named *Benthesicymus brasiliensis*, is recorded from the South-Western Atlantic at a depth of 1900 fathoms, with a bottom temperature of 33°·1 Fahr., or only 1°·1 above freezing point, while a near variety was taken at 2440 fathoms, or about three miles from the surface of the ocean, off the north-western extremity of the Australian continent, and off the western side of New Zealand at 1100 fathoms, and another amongst the narrow channels of the Philippine Islands at 1050 fathoms, and again off the Fiji Islands in about 315 fathoms.

Specimens of *Benthesicymus pleocanthus* were taken at 1050 fathoms, off the northern extremity of the Philippine Islands, and also in the same parallel of latitude in the

middle of the North Pacific Ocean. An imperfect specimen of what appears to be the same species was taken off the island of Sombrero, in the West Indies, at a depth of 450 fathoms. *Benthesicymus iridescens*, which approaches in form the genus *Gennadas*, was secured in 1900 fathoms, near the island of Tristan da Cunha, in the South Atlantic Ocean.

Thus, as will be more fully shown in that part of this Report dealing with the General Distribution, all the species, with the exception of *Benthesicymus altus*, were taken at a greater depth than 1000 fathoms. One specimen of *Benthesicymus brasiliensis* was taken near the Fiji Islands, at 315 fathoms, but this was probably a migrant from the deeper waters of the Eastern Pacific; one specimen of *Benthesicymus altus* was taken at 1400 fathoms, but that was in a deep ravine between two banks, where the water becomes shallow from the ocean towards Torres Strait, and another at 1900 fathoms in the South Atlantic.

In the nearly allied genus *Gennadas* a similar bathymetrical distribution is found; specimens were taken at six stations, where the depth was greater than 1000 fathoms, and at two where the depth was 345 and 565 fathoms respectively.

All the specimens of the two genera recorded from thirty stations were taken by the trawl, with the exception of those at Stations 23, 45, 173 and 214, where the dredge alone was used, and Station 232, where both dredge and trawl were employed. At Station 267 the depth is given as 2700 fathoms, but the specimen is labelled as having been captured in the towing net, which was sent down to 2000 fathoms, and therefore did not reach the bottom by some 700 fathoms. The fact that the specimens were captured more abundantly by the trawl than by the dredge seems to suggest that they are free-swimming animals and that their most frequented home is at some distance from the sea bottom. This appears, moreover, to receive support from the feeble condition of the pereiopoda and the powerful natatory character of the pleopoda.

Most of the specimens, excepting those of *Benthesicymus altus*, were brought up in a soft, pulpy, and collapsed condition.

Benthesicymus crenatus, Spence Bate (Pls. LIV., LV.).

Benthesicymus crenatus, Sp. B., *loc. cit.*, p. 190.

Rostrum short, sharp pointed, laterally compressed, dorsally crested, and armed with three small teeth on the crest and one immediately posterior to it.

Posterior margin of the fourth somite of the pleon evenly crenated. Fifth somite produced posteriorly to a small sharp tooth.

Marginal tooth of the outer branch of the rhipidura not situated at the extremity.

Telson half the length of the rhipidura, tapering, unarmed and fringed with hairs.

Length (female), 200 mm. (8 in.).

Habitat.—Station 272, September 8, 1875; lat. 3° 48′ S., long. 152° 56′ E.; north of the Low Archipelago; depth, 2600 fathoms; bottom, Radiolarian ooze; bottom temperature, 35°·1. One specimen. Trawled.

Station 276, September 16, 1875; lat. 13° 28′ S., long. 149° 30′ W.; near the Low Archipelago; depth, 2350 fathoms; bottom, red clay; bottom temperature, 35°·1. Two specimens were taken; one a female 150 mm. (6 in.) in length, the other about 75 mm. (3 in.), apparently a female also. Trawled.

The external tissue is thin, soft and submembranous in structure.

Carapace furnished with a short, sharp-pointed rostrum, which is laterally compressed, elevated above the orbit to a crest armed with three small teeth and one behind it; inferior margin ciliated. Dorsal carina lost at the cervical fossa, scarcely visible over the gastric region, but reappears slightly over the cardiac. Cervical fossa deep; a slight groove divides the cardiac region into two portions, and the branchial region is defined by a strong elevated ridge, which is lost anteriorly in the hepatic sulcus, which is furnished with a short stout tooth. There is no distinct orbit, and no orbital tooth, but there is a small antennal tooth, and a smaller one below it on the frontal margin.

The pleon is dorsally smooth and even, but laterally compressed posterior to the third somite. The fourth somite is carinated in the median line and posteriorly projected in the form of a small tooth; and has the posterior margin more evenly crenated than shown in the plate. The fifth somite is carinated in its entire length, and terminates in a small sharp tooth; the posterior margin of the somite is smooth and even. The sixth somite is more distinctly crested, and terminates in a small tooth.

The telson is long and pointed, dorsally flat, and has the sides compressed.

The ophthalmus is borne on a moderately long, club-shaped, single-jointed ophthalmopod (Pl. LIV., *a*), which is curved, compressed, and fits into a hollow on the outer and upper surface of the first joint of the first antenna.

The first pair of antennæ (*b*, *b″*) has the first joint short, not longer than the ophthalmopod, and armed on the outer margin with a short robust stylocerite, between the base of which and the anterior margin is an oblique hollow in which the ophthalmopod is lodged. The second and third joints are scarcely equal in length to the first; the third bears two long flagella, the extremities of which are broken, so that their length cannot be determined.

The second pair of antennæ (*c*) carries a large scaphocerite that extends to more than twice the length of the peduncle of the first pair, and is armed with a sharp subapical tooth on the outer side, and the second joint of the peduncle is furnished on the inner distal angle with a strong anccecerite (*c″*).

The mandibles (*d*) are large, and have a two-jointed synaphipod, the first joint of which is large, broad, and foliaceous, and the second narrow, long, and subfoliaceous. The

psalisiform margin is thick and smooth, and the left blade locks within the right. Anterior to the mandibles a large triangulate cheiloglossa is connected with a raised and anteriorly-directed epistoma. Posterior to the mandibles are the metastomata, a pair of membranous, pear-shaped, subfoliaceous appendages.

The first pair of siagnopoda (*e*) is three-branched; the first two branches are foliaceous, and broad at the extremity, where they are fringed with short spines; the third or outer is lunate, subfoliaceous, and terminates in a point.

The second pair of siagnopoda (*f*) consists of three foliaceous branches; the first two are biramose, the extremity of each branch being fringed with short, thick-set hairs, and the third is short, somewhat rigid and pointed; at the base is attached a broad, foliaceous mastigobranchial plate that projects both anteriorly and posteriorly and is fringed with hairs.

The third pair of siagnopoda (*g*) consists of three branches, of which the first or inner branch is broad, thick, ovate at the apex and fringed with hairs on the inner margin. The middle branch is three-jointed; the last joint is very small, the penultimate broad, and the first long, and from its base there springs a membranous branch, the extremity of which tapers and becomes thread-like; from the coxa arises a broad, divided, mastigobranchial plate, one portion of which is directed forwards, and the other posteriorly.

The first pair of gnathopoda (*h*) is seven-jointed; the coxa is short and carries a saccular, membranous, mastigobranchial plate, to the base of which a large podobranchial plume is attached; the basis is short and carries a long filiform ecphysis; the meros is long, broad, stout on the outer and thin on the inner side, which is fringed with hairs; the carpos is short, triangulate, and narrow at the meral articulation. The propodos is broader than the carpos, and the dactylos is short, ovate, and not unguiculate. The three distal joints lie folded back on the inner surface of the meros.

The second pair of gnathopoda (*i*) is pediform; the coxa is short and carries an ovate, pedunculated mastigobranchial plate, to which a branchial plume is attached; the basis is short and carries a filiform ecphysis, not so long proportionally as that of the first pair; the ischium is narrow and longer than the meros, which equals the carpos and propodos in length, while the dactylos is short, curved, having the margins fringed with hairs, and the extremity flattened and distally rounded, tipped with a small, curved, sharp, unguis.

The three anterior pairs of pereiopoda are slender and chelate, of these the first pair is the shortest and the third the longest. The fourth pair is longer and more slender than the third, and terminates in a styliform dactylos. It likewise carries a mastigobranchia, but unlike those of the preceding pairs it has no podobranchial plume attached. The posterior pair of pereiopoda is extremely long and very slender, and terminates in a styliform dactylos, but it carries no mastigobranchial plate or podobranchial plume.

The first pair of pleopoda in the female is single-branched, the ramus being long and tapering to a filamentous extremity, and supported on a stout basisal joint, near the base of which on the inner side there is a rudimentary membranous appendage. The second

pair resembles the first in general form, but it has the second or anterior branch in the form of a small and slender filament attached to the anterior distal extremity of the basisal joint. The three succeeding pairs resemble the second; the anterior branch gradually increases in size with each succeeding pair, and in the last two the anterior is subequal to the posterior branch. The sixth pair of pleopoda, which helps to form the rhipidura, has the outer branch longer than the inner, and is armed on the outer margin with a sharp subapical point that corresponds with the outer extremity of the obsolete diæresis; the inner branch is ovate, unarmed, and longer than the telson.

The description is drawn up from the female taken at Station 272.

Benthesicymus brasiliensis, Spence Bate (Pl. LVII. fig. 1).

Benthesicymus brasiliensis, Sp. B., *loc. cit.*, p. 191.

Rostrum short, flattened laterally, pointed, crest dorsally armed with two teeth and the carina produced posterior to the cervical fossa, gradually decreasing and finally disappearing before it reaches the posterior margin of the carapace. Pleon compressed posteriorly. Third, fourth, and fifth somites with dorsal median ridge, posteriorly produced to a small tooth, the sixth somite furnished with a distinct carina, but not posteriorly produced to a tooth.

Telson dorsally flattened, laterally compressed, terminally pointed, and marginally fringed with hairs, rather more than half the length of the outer branch of the rhipidura.

Length—male, 127 mm. (5 in.); female, 152 mm. (6 in.).

Habitat.—Station 323, February 28, 1876; lat. 35° 39′ S., long. 50° 47′ W.; east of Buenos Ayres; depth, 1900 fathoms; bottom, blue mud; bottom temperature, 33°·1. Four specimens; two males and two females; one of each half-grown and one full-sized. Trawled.

Station 168, July 8, 1874; lat. 40° 28′ S., long. 177° 43′ E.; off New Zealand; depth, 1100 fathoms; bottom, blue mud; bottom temperature 37°·2. Two females, half-grown. Trawled.

Station 173, July 24, 1874; lat. 19° 9″ 35′ S., long. 179° 41″ 50′ E.; off Matuku, Fiji Islands; depth, 315 fathoms; bottom, coral mud. One male, full grown. Dredged.

Station 181, August 25, 1874; lat. 13° 50′ S., long. 151° 49′ E.; between Australia and the Solomon Islands; depth, 2440 fathoms; bottom, red clay; bottom temperature, 35°·8. One male, half-grown. Trawled.

Station 184, August 29, 1874; lat. 12° 8′ S., long. 145° 10′ E.; near Torres Strait; depth, 1400 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·0. Three females and one male. Trawled.

Station 285, October 14, 1875; lat. 32° 36′ S., long. 137° 43′ W.; South Pacific; depth, 2375 fathoms; bottom, red clay; bottom temperature, 35°. One female. Trawled.

The external tissue is soft and membranous.

The rostrum is short, and tapers rather suddenly to a sharp point. The crest is narrow, armed with two small teeth, and the carina can be traced to very nearly the posterior margin of the carapace. The dorsal surface of the pleon is smooth until the third somite, where a small carina commences, which culminates in a small but distinct tooth in the median line of the posterior margin of the third, fourth, and fifth somites, and increases to a distinct carina on the sixth somite, terminating abruptly on the posterior margin.

The telson is dorsally flattened, laterally compressed, tapering, and armed on each side with three small spinules; the last two are subapical, and between them are two others.

This species is exceedingly like *Benthesicymus altus*, but may at once be distinguished from it by the soft membranous condition of the external tissues, the presence of the small tooth on the posterior margin of the three somites preceding the last, and the absence of the transverse elevation of the posterior margin of the sixth somite.

The ophthalmopod is obliquely flattened, soft, and flexible, and is furnished near the middle of the inner margin with a very decided blunt tubercle, with a single lens.

The ophthalmus is orbicular, equal in breadth to the greatest diameter of the flattened stalk, and of a yellowish-white colour; a little dark pigment lies at its base near the centre. The ophthalmopod reaches as far as the extremity of the rostrum and equals the stylocerite in length.

The first joint of the first pair of antennæ extends a little beyond the extremity of the eye, and is armed on the outer side with a stylocerite that is large and flattened on the outer side, and has no tooth on the distal angle, but is reduced to a mere point at the extremity. The next two joints are short and terminate in two long, rather rigid, multiarticulate flagella.

The second pair carries a long and broad scaphocerite that terminates in an ovate extremity, and is strengthened by a median rib and an external ridge that ends in a small tooth considerably short of the extremity; on the inner side of the coxal joint is a small phymacerite, and on the upper side of the third joint of the peduncle a small, rigid, fixed hook (ancecerite); it terminates in a long and slender flagellum.

The other appendages may be compared with those of *Benthesicymus altus*.

The pereiopoda, especially the chelate pairs, are long and more slender. The ventral surface of the pereion, in the female, is thickly matted with hairs; the oviducts are large and come into contact with those on the opposite side; between the fourth pair is an ovate thelycum directed anteriorly, behind which the surface is small and smooth, and there is no tooth or tubercular process between the first pair of pleopoda.

The first pair of pleopoda in the female is similar to that in *Benthesicymus altus*. In the male the petasma is moderately large, pear-shaped, and carries a marginal process on the outer side. The second pair has two rami, one long, the other very short and slender, and at its base a small scale-like plate. All the others are similar in both sexes,

and the rhipidura much resembles that in *Benthesicymus altus*, except that the telson is scarcely as long in proportion.

The larger specimens of this species were taken off Brazil. Some were taken at the western side of Torres Strait, but these were all smaller, and close examination shows that they differ in the unimportant character of having no tooth on the posterior margin of the third somite of the pleon, and the thelycum on the ventral surface of the pereion is rather more conspicuous. These were taken at a depth of rather more than two miles and a half, where the temperature was 4° above freezing point; the bottom where specimens were taken was unlike in character; in two localities it was blue mud, in one it was red clay, in one it was coral mud, and in one Globigerina ooze.

Benthesicymus pleocanthus, n. sp. (Pl. LVII. fig. 2).

Surface membranous. Rostrum short, pointed, crest armed with two teeth, the anterior of which is the smaller. Cervical fossa clearly defined, but not deep. Pleon with the posterior somites laterally compressed, and the dorsal surface of the fifth somite posteriorly produced in the median line to a laterally compressed tooth, which nearly equals the somite in length. The sixth somite is deep, and carries a distinct but not high ridge in the median dorsal line. The telson tapers to a point, is smooth at the sides, and quite half the length of the outer branch of the rhipidura.

Length, 76 mm. (3 in.).

Station 23, March 15, 1873; lat. 18° 24′ N., long. 63° 28′ W.; off Sombrero Island; depth, 450 fathoms; bottom, Pteropod ooze. One specimen, female; evidently that from which Suhm's figure was taken. Dredged.

Habitat.—Station 205, November 13, 1874; lat. 16° 42′ N., long. 119° 22′ E; Philippine Islands; depth, 1050 fathoms; bottom, blue mud; bottom temperature, 37°. Two specimens, one male and one female. Trawled.

Station 250, July 9, 1875; lat. 37° 49′ N., long. 166° 47′ W.; North Pacific Ocean; depth, 3050 fathoms; bottom, red clay; bottom temperature, 35°. Two specimens, both males. Trawled.

The specimens taken at both Stations differ in the position of the large dorsal tooth on the fifth somite of the pleon. In the males, of which there are three, it stands near the middle of the somite, in the fourth, which is a female, it stands on the posterior margin, but this variation in position appears to depend more upon the recession of the dorsal portion of the posterior division of the somite than upon any alteration in the dorsal tooth. In the males also the small patch of black pigment is situated as a spot near the middle of the ophthalmopod and distant from the base of the ophthalmus, while in the female it traverses the ophthalmopod from the eye to the base in an undefined mass.

The accompanying figure is slightly reduced from a drawing of this specimen made by Suhm when the animal was fresh, and was probably the first specimen ever captured of this genus. It has a small prominence on the middle of the fifth somite of the pleon (more clearly represented in the author's drawing than in the woodcut), which evidently

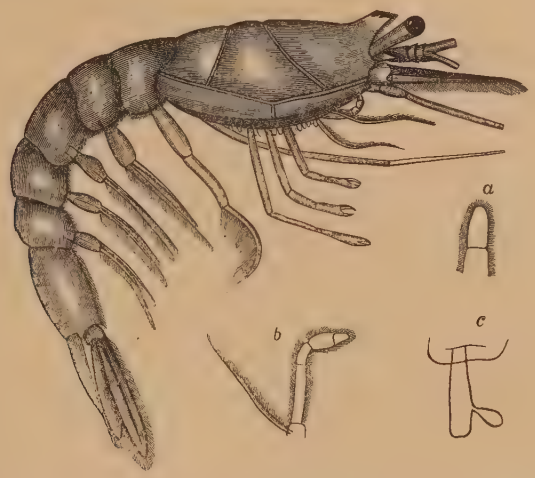

FIG. 48.—"Decapoden. ×2 nat. size, male specimen. Journal 28th of April 73, No. 2. Close to Sombrero, W. I., 450 fathoms, 15 March 73, nat. size 80 mm.; *a*, mandible; *b*, 3d maxilliped; *c*, 1st joint of first pair of abdominal feet with small leaf-formed appendage at the inner side." MSS. Willemoes-Suhm. Reduced one-third.

is the remains of the long spine-like tooth characteristic of this species, and in all other respects it appears to correspond closely with the eastern specimens. Although it is the only specimen recorded from the Atlantic, yet since it is represented in the Pacific and Eastern Archipelago we may assume it to be as freely distributed as some of the allied species.

Benthesicymus iridescens, Spence Bate (Pl. LVI. figs. 1, 2; Pl. LVII. fig. 3).

Benthesicymus iridescens, Sp. B., Ann. and Mag. Nat. Hist., *loc. cit.*

Rostrum short, pointed, but not sharply, laterally compressed, dorsally crested, armed with one small tooth rather behind the orbital margin, and a small point indicative of another tooth on the gastric region. There is no tooth on the dorsal surface of the pleon, the posterior margin of the fourth somite of the pleon is smooth, and the telson nearly as long as the inner ramus of the rhipidura.

The ophthalmopod is longer than the rostrum and terminates bluntly, carrying two unequal flagella.

The first pair of antennæ has the first joint of the peduncle a little longer than the ophthalmopod; the stylocerite is scarcely so long, but reaches nearly as far as the

extremity of the ophthalmopod. In most other respects the species resembles *Benthesicymus brasiliensis.*

Length (male), 150 mm. (6 in.) measured from tip of rostrum to extremity of telson.

Habitat.—Station 133, October 11, 1873; lat. 35° 41′ S., long. 20° 55′ W.; in the South Atlantic, near Tristan da Cunha; depth, 1900 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·4. Two specimens; the larger is a male, the smaller, which is a female about 50 mm. in length, is more slender, but I take it to be a younger specimen of this species. Trawled.

Benthesicymus altus, Spence Bate (Pl. LVIII. fig. 1).

Benthesicymus altus, Sp. B., *loc. cit.*, p. 191.

Rostrum short, compressed, thin, apex styliform, crest armed with two teeth and terminating at the cervical fossa, which is clearly marked. The posterior three somites of the pleon are much compressed, and the last is dorsally furnished with a small but decided carina. The males are like the females, but with the dorsal ridge on the fifth and sixth somites produced to a minute tooth at the posterior extremity. Telson half the length of the outer branch of the rhipidura, sides laterally compressed, posterior half armed with three small distant spines.

Habitat.—Station 184, August 29, 1874; lat. 12° 8′ S., long. 145° 10′ E.; between Australia and New Guinea; depth, 1400 fathoms; bottom, Globigerina ooze; bottom temperature, 36°. One specimen, associated with a smaller one closely resembling *Benthesicymus brasiliensis.* Trawled.

Length (female), 120 mm. (4·75 in.).

Station 214, February 10, 1875; lat. 4° 33′ N., long. 127° 6′ E.; south of the Philippines; depth, 500 fathoms; bottom, blue mud; bottom temperature, 41°·8. Three males. Dredged.

Length, 63 mm. (2·5 in.).

Station 170, July 14, 1874; lat. 29° 55′ S., long. 178° 14′ W.; off the Kermadec Islands; depth, 520 fathoms; bottom, volcanic mud; bottom temperature, 43°. Trawled.

Station 171, July 15, 1874; lat. 28° 33′ S., long. 177° 50′ W.; north of the Kermadec Islands; depth, 600 fathoms; bottom, hard ground; bottom temperature, 39°·5. Numerous specimens. Trawled.

Station 174c, August 3, 1874; lat. 19° 7′ 50″ S., long. 178° 19′ 35″ E.; off Kandavu, Fiji; depth, 610 fathoms; bottom, coral mud; bottom temperature, 39°. A sickly-looking specimen, destitute of scaphocerite and rostrum. Trawled.

Station 205, November 13, 1874; lat. 16° 42′ N., long. 119° 22′ E.; Philippine Islands; depth, 1050 fathoms; bottom, blue mud; bottom temperature, 37°·0. One female. Trawled.

Station 232, May 12, 1875; lat. 35° 11′ N., long. 139° 28′ E.; off Japan; depth, 345 fathoms; bottom, green mud; bottom temperature, 41°·1. Trawl and dredge both used.

Station 235, June 4, 1875; lat. 34° 7′ N., long. 138° E.; south of Japan; depth, 565 fathoms; bottom, green mud; bottom temperature, 38°·1. Four specimens; three males, one female. Trawled.

Station 133, October 11, 1873; lat. 35° 41′ S., long. 20° 55′ W.; near Tristan da Cunha; depth, 1900 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·4. Three male specimens. Length, largest, 85 mm. (3·4 in.); smallest, 41 mm. (1·6 in.). Trawled.

The external tissue is more firm and rigid than usual in this genus. The rostrum is short and pointed, tapering slenderly; crest thin and armed with two small teeth; carina terminating at the anterior margin of the cervical suture, posterior to which the dorsal surface is smooth and even, excepting for a slight carina which commences on the posterior half of the fifth somite, culminates in a small but distinct carina on the middle of the sixth, and is finally lost before it reaches the posterior margin, which is transversely elevated. The telson (fig. 1z) is dorsally flattened and laterally compressed, tapering slightly, and armed with three small spines on each side, the first of which is just beyond the middle, and the last subapical; the spaces between the teeth are fringed with hairs.

This species is very like *Benthesicymus brasiliensis*, but may easily be distinguished by its being more slender, by the firmness and rigidity of the external tissue, by the absence of any teeth on the dorsal surface of the pleon, and by the peculiar transverse elevation of the posterior margin of the sixth somite.

The ophthalmopod (fig. 1*a*) is flattened, membranous and flexible, and is furnished on the inner margin near the base with a small tubercle; it reaches to the extremity of the rostrum, but falls short of that of the stylocerite; it is of a yellowish-white colour, with a transverse line of dark pigment across the base. The ophthalmus is orbicular, and of about the same diameter as the greatest breadth of the stalk.

The first pair of antennæ has the first joint of the peduncle scarcely longer than the ophthalmopod; it is armed on the outer side with a strong sharp stylocerite, that reaches to nearly the extremity of the joint, the outer angle of which is armed with a strong tooth. The second and third joints are short, subequal, and distally support two long flagella, the multiarticulation of which is very marked.

The second pair of antennæ supports a long scaphocerite, slightly tapering until beyond the external marginal tooth, which falls considerably short of the distal extremity; the flagellum is long and slender, more slender than the smaller flagellum of the first pair.

The metope is flat and smooth, and the epistoma projects over it in the form of an angular rostrum.

The synaphipod of the mandibles has both the joints tolerably broad, flat and strong.

The second pair of gnathopoda is long and robust, reaching beyond the extremity of the peduncle of the first pair of antennæ, and terminating in a small, compressed, curved dactylos; it is thickly fringed with hairs and carries a long, slender basecphysis; like the pereiopoda it has no tooth at the base.

The first pair of pereiopoda is short and moderately strong, and each succeeding pair increases in length and becomes more slender, so that the last two pairs are exceedingly long and slender.

On the ventral surface of the pereion there is an orange-coloured, discoid mass between the coxæ of the fourth pair of pereiopoda, immediately posterior to the extremity of the projecting processes on the third pair of pereiopoda that carry the oviducts, while the surface between, and posterior to the last pair of pereiopoda, is smooth and even as far as the median line between the first pair of pleopoda, where there arises a large, laterally compressed, anteriorly pointed and posteriorly curved tooth.

The first pair of pleopoda is long, slender, and single-branched; a rudimentary membranous petasma exists on the inner side of the basisal joint. All the other pleopoda are biramose, the outer or posterior branch being long, and the inner one short; they gradually decrease in length but gain in equality posteriorly. The posterior pair forms the branches of the rhipidura. The outer is much longer than the inner, and the inner is much longer than the telson, and is leaf-like and partly strengthened by a rib in the median line; the outer is ovate, and strengthened by a rib that meets the outer margin considerably short of the distal extremity.

The branchiæ are of generic value, but differ a little in the relative proportions of the several plumes. The pleurobranchiæ are small but increase in size posteriorly, yet the last, although the longest, is not a large or important appendage. The arthrobranchiæ are large and overlap each other, except in the last pair, where there is no podobranchial plume, whereas a long and well-developed podobranchial plume is attached to every mastigobranchia except that which belongs to the penultimate pair of pereiopoda. The mastigobranchiæ are all thick and fleshy, and have the surface marked with numerous straggling hairs.

Thus there are seven pleurobranchiæ, twelve arthrobranchiæ, five podobranchiæ, and six mastigobranchiæ, the tendency of which is to increase in size posteriorly.

About fifty miles south of Japan, just where the water rapidly deepens from a hundred fathoms to between three and four thousand, four specimens were taken; three of them were males, about half the size of the female, and had the eyes in one instance dark brown all over, while in the others the brown pigment affected only the base of the eye, but to a greater extent than in the specimen described. The bottom was green mud, and the temperature was 2°·1 higher than at Station 184. At the eastern entrance of Torres Strait, it was taken with the trawl in a deep ravine between the hundred fathom areas that surround the New Guinea and Australian coasts, being the deepest water in which this species has been taken.

Benthesicymus mollis, n. sp. (Pl. LVIII. fig. 2).

This species very closely resembles *Benthesicymus brasiliensis*, so much so that I considered it to be that species, until I examined the structure of the branchial plumes and found them to have the ultimate lobes both broader and shorter. The telson (fig. 2z) which is partially damaged in the specimen taken as the type, is deeply grooved dorsally to the anterior extremity.

The texture of the external surface is extremely thin and soft, as in most specimens of this genus.

Length, 76 mm. (3 in.).

Habitat.—Station 133, October 11, 1873; lat. 35° 41′ S., long. 20° 55′ W.; near Tristan da Cunha; depth, 1900 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·4. Trawled.

Gennadas, Spence Bate.

Gennadas, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 191, 1881.

Resembles *Benthesicymus*, but differs in having the dactylos of the second pair of gnathopoda spatuliform, instead of cylindrical and sharp. The rostrum is short, laterally compressed and dorsally crested. The ophthalmopod is flattened and carries a large tubercle or complementary eye on the inner margin. The first pair of antennæ is about half the length of the carapace and has the second and third joints broad. The first joint is deeply excavated to receive the eye, and the terminal joint articulates with the second at the inferior angle only, and carries two long flagella of unequal diameter. The second pair of antennæ is long and slender, and carries a large scaphocerite that gradually narrows towards the distal extremity.

The mandibles carry a two-jointed synaphipod of which the first joint is broad and ovate, and the second narrow.

The first pair of gnathopoda is short and has the meros broad and squamiform.

The second pair is seven-jointed, long and narrow, and terminates in a spatuliform dactylos.

The first pair of pereiopoda is chelate, short and robust. The second is chelate, long and stout. The third is still longer and rather slender, and the two posterior are long, slender and feeble.

Both pairs of gnathopoda carry a mastigobranchial plate and a podobranchial plume, two arthrobranchiæ, and a small pleurobranchia. The mastigobranchiæ are rudimentary in their proportions, but become slightly larger on the penultimate pair of pereiopoda, where there is no podobranchial plume, and are altogether absent from the ultimate pair of pereiopoda, as also are the arthrobranchiæ, the pleurobranchial plume alone being retained.

The branchial arrangement consists of a series of evenly ranged branches disposed in pinnate fashion on each side of a central stalk, like the leaves of an ash tree, each lateral branch closely representing the whole plume, and increasing in size as they approach the base, the leaflets becoming changed from a cylindrical to a foliaceous condition (Pl. LIX., *Br*).

The several plumes fill the branchial chamber and may be formulated as in the following table :—

Pleurobranchiæ,	.	.	.	r	r	1	1	1	1	1
Arthrobranchiæ,	.	.	.	2	2	2	2	2	2	...
Podobranchiæ,	.	.	.	1	1	1	1	1	...	...
Mastigobranchiæ,	.	.	.	r	r	r	r	r	r	...
				h	i	k	l	m	n	o

The bathymetrical range of the genus is from 300 to 3050 fathoms; it was chiefly got from the greater depths, and the animals are undoubtedly natatorial in habit and probably never rest upon the bottom of the ocean.

Gennadas is very closely allied to *Benthesicymus* but must be considered a distinct genus. It may be most readily distinguished by the form of the dactylos of the second pair of gnathopoda, and by having only one tooth surmounting the crest, but most especially by the more simple character and ultimate structure of the branchial plumes, and by the rudimentary condition of the mastigobranchial plates.

Geographical Distribution.—Species of this genus appear to be very generally distributed in the ocean at an average depth of about 2000 fathoms. But two of the three instances in which they were got in comparatively shallow water were at localities near the border line to the south of Japan, where the bottom rapidly dips from 100 to 1000 fathoms, and the other, in the Chinese Sea, was under similar conditions. It may be that at certain periods the animals ascend to a warmer stratum of water to deposit their ova.

Although the specimens are far from abundant (only in two instances have more than solitary specimens been taken, and then only three and four respectively), yet they have been found in the North and South Atlantic Oceans, near both the Old and New Continents, in the middle of the North and South Pacific, as well as near the coasts of Japan and China, in the Indian Ocean, and south of Australia.

Gennadas parvus, Spence Bate (Pl. LIX.).

Gennadas parvus, Sp. B., *loc. cit.*, p 192.

Rostrum short, laterally compressed, thin, apex pointed, crest armed with one tooth, Cervical fossa not deep. Posterior somites of the pleon laterally compressed, dorsal surface without a carina, but the posterior somite showing a median line or low ridge. Telson short, scarcely half the length of the outer branches of the rhipidura.

Habitat.—Station 230, April 5, 1875; lat. 26° 29′ N., long. 137° 57′ E.; south of Japan; depth, 2425 fathoms; bottom, red clay; bottom temperature, 35°·5. Trawled.

Length of adult male, 30 mm. (1·25 in.).

Station 45, May 3, 1873; lat. 38° 34′ N., long. 72° 10′ W.; off the mouth of the Delaware; depth, 1240 fathoms; bottom, blue mud; bottom temperature, 37°·2. Dredged.

Length (male), 25 mm. (1 in.).

Station 101, Aug. 19, 1873; lat. 5° 48′ N., long. 14° 20′ W.; off Sierra Leone; depth, 2500 fathoms; bottom, blue mud; bottom temperature, 36°·4. Trawled.

A specimen was taken (fig. 2) rather more than 1 inch in length, that had been attacked by a worm that appears to be related to *Gordius*. There is nothing to show whether it was killed by the worm or only attacked after death. The structure of the external tissue is soft and submembranous, but the regions on the carapace are clearly marked.

Station 120, September 9, 1873; lat. 8° 37′ S., long. 34° 28′ W.; off Pernambuco; depth, 675 fathoms; bottom, red mud. Trawled.

Length (male), 46 mm. (1·8 in.).

Station 159, March 10, 1874; lat. 47° 25′ S., long. 130° 22′ E.; south of Australia; depth, 2150 fathoms; bottom, Globigerina ooze; bottom temperature, 34°·5. Trawled.

Station 206, January 8, 1875; lat. 17° 54′ N., long. 117° 14′ E.; west of Manila, Philippines; depth, 2100 fathoms; bottom, blue mud; bottom temperature, 36°·5. Trawled.

Length (female), 32 mm. (1·25 in.).

Station 220, March 11, 1874; lat. 0° 42′ S., long. 147° E.; north of New Guinea; depth, 1100 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·2. Three specimens, females. Trawled.

Length of largest, 25 mm. (1 in.)

Station 232, May 12, 1875; lat. 35° 11′ N., long. 139° 28′ E.; south of Japan; depth, 345 fathoms; bottom, green mud; bottom temperature, 41°·1. Four specimens; two males and two females. Trawl and dredge were both used, but by which taken is not recorded.

Length, 50 mm. (2 in.).

Station 235, June 4, 1875; lat. 34° 7′ N., long. 138° E.; south of Japan; depth, 565 fathoms; bottom, green mud; bottom temperature, 38°·1. Trawled.

Length (female), 50 mm. (2 in.).

Station 237, June 17, 1875; lat. 34° 37′ N., long. 140° 32′ E.; near Yokohama; depth, 1875 fathoms; bottom, blue mud; bottom temperature, 35°·3. One female. Trawled.

Length, 52 mm. (2 in.).

Station 250, July 9, 1875; lat. 37° 49′ N., long. 166° 47′ W.; mid-ocean, North Pacific; depth, 3050 fathoms; bottom, red clay; bottom temperature, 35°·0. Trawled.

Station 267, August 28, 1875, lat. 9° 28′ N., long. 150° 49′ W.; mid-ocean, North Pacific; depth, 2700 fathoms; bottom, Radiolarian ooze; bottom temperature, 35°·0.

Station 289, October 23, 1875; lat. 39° 41′ S., long. 131° 23′ W.; South Pacific Ocean; depth, 2550 fathoms; bottom, red clay; bottom temperature, 34°·8. Trawled.

Length (male), 25 mm. (1 in.).

The rostral crest is not greatly elevated, and is furnished with only one tooth on the upper margin, and behind it a very minute point. The animal offers no peculiar characters, except that there is a regular fringe of fine hairs on the infero-lateral margin of the sixth somite, and a slight indication of a dorsal carina; the telson in relation to the length of the other tail appendages is rather short, and the extremity is somewhat truncated and flanked by two small points or denticles.

The ophthalmopod is longer than the rostrum, flattened, and slightly curved; it is furnished near the base with a very prominent tooth-like process; the small tubercle common to the species of *Benthesicymus* being here largely developed. The ophthalmus, at the extremity of the ophthalmopod, is orbicular, not of greater diameter than the stalk, and of a brown colour, with a small mass of black pigment at the base.

The first pair of antennæ has the peduncle long. The first joint extends considerably beyond the rostrum and is hollowed on the upper surface to receive the ophthalmopod, the floor of the depression being paved with minute spinules; it is robust on the inner side, lobed anteriorly on the upper surface and very thin on the outer side, where it is armed with a short stout stylocerite. The second joint is short and lobed on the upper surface; the third is longer than the second, and articulates with it at the inferior angle, and is lobed on the upper surface posteriorly; it carries two flagella, of which the upper is broad at the base, and supports a closely-packed series of very long, slender, membranous cilia, and suddenly narrows to a slender filamentous termination. The lower is continuously slender from the base.

The second pair of antennæ has a slender flagellum, rather longer than the animal, and supports a scaphocerite that is longer than the peduncle of the first pair and terminates in an ovate extremity, and the margin is fringed with numerous multi-articulate ciliated hairs and is without an outer subapical tooth.

The mandible supports a large two-jointed synaphipod, the extremity of which reaches beyond the distal extremity of the peduncle of the second pair of antennæ; the first joint is broad and foliaceous, the second narrow and foliaceous.

The second pair of gnathopoda is long, has the meros and ischium long and broad, the carpos long, narrow, and subequal to the propodos, and terminates in a broad, flat, palm-like dactylos.

The first pair of pereiopoda is short, robust, and terminates in a short robust chela. The second pair is long and slender. The third is still longer and more slender, but is lost in the typical male specimen (but preserved in the female from another station). The penultimate pair is long, slender, and styliform. The posterior pair is wanting in

our typical specimen, but the coxa in comparison with that of the preceding pair is remarkable for its large size.

The first pair of pleopoda is single-branched, moderately long, and has a large membranous curtain attached to the base of the first joint, which extends across the ventral surface and is united in the median line to its fellow on the opposite side by a series of cincinnuli.

The second pair of pleopoda is biramose, the anterior ramus being shorter than the posterior; two small membranous leaf-like appendages are attached to the anterior extremity of the peduncle.

The third and following pairs of pleopoda are two-branched, the outer or posterior branch being the longer.

The sixth or ultimate pair has the branches subequal, slender, tapering, fringed with tolerably long hairs, and twice as long as the telson.

This interesting form is so closely allied in general structure to *Benthesicymus*, that I hesitated to remove it from that genus. But the characteristic formation of the second pair of gnathopoda, the large secondary eye-tubercle, the peculiar form of the articulation of the third joint of the first pair of antennæ, together with the structure of the branchiæ, compel me to place it in a separate genus.

The specimens taken at Stations 232 and 235, near the southern shores of Japan, were got in comparatively shallow water, the depths being 345 and 565 fathoms respectively, or something less than from half to three-quarters of a mile from the surface.

The specimens from these stations, most of which are females, are nearly twice as long as the fully-developed male from Station 230 in the same locality, but where the water is three miles deep, which was only 30 mm. long, about the length of most others from similar depths.

Gennadas intermedius, n. sp. (Pl. LVIII. fig. 3).

External structure soft and membranous. Carapace anteriorly produced to a broad, sharply-pointed rostrum that is not more than half the length of the ophthalmopoda. Near the apex a thin carina arises which is dorsally elevated to a crest, that is armed with a single tooth above the frontal margin, and by the rudiment of another still further behind, but in advance of the gastric region. The rest of the animal corresponds in general appearance with *Gennadas parvus*.

The ophthalmopoda are nearly half the length of the peduncle of the first pair of antennæ, are obliquely compressed, support an ophthalmus which is not of greater diameter, and bear on the inner side a prominent tooth-like process that reaches as far as the base of the ophthalmus, and gradually tapers to a point which is furnished with one small lens.

The first pair of antennæ has the first joint broad, excavated on the upper surface, and armed on the outer with a stout stylocerite about half the length of the joint, the outer distal angle of which is rounded and fringed with long ciliated hairs. The second joint is about half the length of the first, and the third is stouter and rather longer than the second; the flagella are broken short off.

The second pair of antennæ is furnished with a long, slightly curved ancecerite, and with a broad and somewhat tapering scaphocerite, smooth on the outer surface and fringed on the inner with long, ciliated hairs, and reaching as far as the distal extremity of the third joint of the peduncle of the first pair.

The epistoma projects in the form of a rounded protuberance.

The mandibles support a long, two-jointed synaphipod of extreme thinness; the first joint is broad and ovate, and the second narrow and tapering, its extremity reaching as far as the distal border of the first joint of the first pair of antennæ.

The oral appendages are of extreme delicacy and tenuity.

The first pair of gnathopoda has the meral joint extremely broad and very thin, the margins being thickly fringed with hairs; the basis supports a long ecphysis, and the coxa carries a podobranchial plume attached to a rudimentary mastigobranchia.

The second pair of gnathopoda carries a podobranchial plume borne upon a rudimentary mastigobranchia attached to the coxa; the basis carries a long and slender ecphysis; the ischium and meros articulate, and the latter is enlarged to a broad plate of extreme tenuity; the two succeeding joints are narrow. The dactylos is spatuliform, curved, and terminates in a slender but stiff spine, more like *Benthesicymus* than *Gennadas;* on the outer surface the dactylos is furnished with a small but distinct process or tooth.

The first pair of pereiopoda is short and slender, but more robust than the second and third, which are successively longer, slighter, and more feeble. The last two pairs are broken off at the ischium.

The first pair of pleopoda in the typical specimen, which is a male, supports a large and well-developed petasma, which resembles that of *Gennadas parvus*, as shown on Pl. LIX., *p*. The others are all biramose and subequal. The rhipidura is damaged, but the telson appears to have been more than half the length of the lateral plates.

Length (male), 45 mm. (1·75 in.).

Habitat.—Station 106, August 25, 1873; lat. 1° 47′ N., long. 24° 26′ W.; off Sierra Leone; depth, 1850 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·6. One specimen. Trawled.

A specimen, 24 mm. in length, was taken at the surface between Bermuda and the Azores, in June 1873.

Station 137, October 23, 1873; lat. 35° 59′ S., long. 1° 34′ E. Surface. One male specimen. Length, 23 mm. (0·9 in.).

The chief differences that separate this species from *Gennadas parvus* are the pointed character of the prominent secondary eye-stalk, the less prominent lobe-like condition of the upper surface of the third joint of the first pair of antennæ, the greater amount of squamiform expansion of the meral and ischial joints of the gnathopoda, the presence of a short, stout tooth on the outer margin of the dactylos, midway between the base and the apex, and of a fine but stiff spine at the extremity, and probably the greater relative length of the telson as compared with the outer plates of the rhipidura.

This specimen was taken along with *Haliporus* and *Acanthephyra*.

Family Sergestidæ.

In this family the diminishing value of the two posterior pairs of pereiopoda is very conspicuous, both becoming small, enfeebled, and in some instances rudimentary, as in *Sergestes*. In *Acetes* the penultimate pair is reduced and the posterior is wanting, while in *Leucifer* they are both entirely absent. The branchial system has also become of diminished importance. The mastigobranchiæ are all wanting except a rudimentary discoid plate at the base of the first pair of gnathopoda; so also are the podobranchial plumes, except a small plume attached to the first gnathopod. The arthrobranchiæ are all wanting in the genus *Sergestes*, but are retained in *Petalidium*, except on the last two pairs of pereiopoda, and the pleurobranchiæ are retained in all the genera in a more or less modified form.

Subfamily Sergestinæ.

This subfamily comprises those genera that possess branchiæ of an impoverished character.

The mastigobranchiæ and podobranchiæ are wanting, excepting a rudimentary pair, attached to the first pair of gnathopoda. The ovum of this subfamily has never been observed, but specimens of an early Zoea stage, believed to belong to this subfamily, have been taken and watched, and I therefore think it probable that the ova are deposited and hatched in the sea, and not carried by the animal. The brephalos is stated to be in the Nauplius form but as yet this is only hypothetical, since its connection with the parent has never been observed. The Zoea form to which Anton Dohrn[1] has given the name of Elaphocaris, is the earliest known stage according to the results of the Challenger exploration. But Professor Brooks states[2] that "the metamorphosis of *Sergestes* is more like that of *Leucifer* than is the case with any known Crustacean except *Acetes*, but our knowledge of *Sergestes* is incomplete."

In this subfamily there are several genera, *Petalidium*, *Sergestes*, *Acetes*, and *Sciacarus*.

[1] *Zeitschr. f. wiss. Zool.*, Bd. xx. p. 607, 1870.

[2] *Phil. Trans.*, p. 111, pl. i., 1882.

Petalidium.

Pleurobranchiæ,	...	...	f	f	f	...	...		
Arthrobranchiæ,	r	1	1	1	1	...	...		
Podobranchiæ,	1	...	...	...	...	...	...		
Mastigobranchiæ,	1	...	...	...	...	...	...		
	h	i	k	l	m	n	o		

Sergestes japonicus.

Pleurobranchiæ,	...	*f*1	*f*1	*f*1	*f*1	2	..		
Arthrobranchiæ,	...	...	...	...	...	...	...		
Podobranchiæ,	1	...	...	...	...	..	...		
Mastigobranchiæ,	1	...	...	...	...	...	...		
	h	i	k	l	m	n	o		

Sergestes kröyeri.

Pleurobranchiæ,	...	*f*1	*f*1	*f*1	2*	2	...		
Arthrobranchiæ,	...	...	...	...	...	...	...		
Podobranchiæ,	1	...	...	...	...	...	...		
Mastigobranchiæ,	1	...	...	...	...	...	...		
	h	i	k	l	m	n	o		

Sergestes prehensilis.

Pleurobranchiæ,	...	1	1	1r	2	2	...		
Arthrobranchiæ,	...	...	...	...	...	...	...		
Podobranchiæ,	1	...	...	...	...	...	...		
Mastigobranchiæ,	1	...	...	...	...	...	...		
	h	i	k	l	m	n	o		

I think it is desirable that the Preliminary Remarks on the Development of some Pelagic Decapods, by Dr. v. Willemoes-Suhm, communicated to the Royal Society, and published in their proceedings,[1] should in justice to him be reproduced here, so that they may have their full weight on the minds of those who may see the drawings of the animals, in which he took great interest.

"Since we left Australia I have investigated the metamorphoses of some Crustacea which have been constantly caught by us on the surface of the tropical and subtropical parts of the Pacific. Though these investigations will be continued, I have now arrived at certain results which I think will not be uninteresting to zoologists. The genera to which these remarks refer are *Amphion*, *Sergestes*, and *Leucifer*.

"*Amphion Reynaudi* has been on our lists as an animal '*incertæ sedis*' (Milne-Edwards) for nearly forty years, until Dorhn proved that a full-grown specimen of it, which he dissected, was in possession of branchiæ and of an ovary, therefore, no doubt, a

[1] *Proc. Roy. Soc.*, vol. xxiv. p. 132, 1876.

mature form. He also described one of its young stages, which has the number of appendages of a *Zoëa*, but in which caudal appendages are already developed.

"On our voyages in the 'Challenger' we have caught several specimens of *Amphion* and of its larvæ; and I am now able to produce drawings, not only of the *true Zoëa* with a simple telson, but also of all the intermediate stages between it and the adult form with two, three, four, five, and six pairs of walking-legs. Of the full-grown *Amphion* I have examined three specimens, two of which are undoubtedly males, as the testes (and the branchiæ) were plainly visible, the former opening into the last pair of legs.

"There is now no doubt that *Amphion* is not a larva, nay, even that there are several species and perhaps genera of this remarkable form.

"We have caught two very interesting mature animals which are certainly closely allied to *Amphion*. One of these has enormously long eye-stalks, which, having a length of 7 millims., are just as long as the whole animal's body.

"Another form has got very long eye-stalks too, but is especially remarkable for the antepenultimate joints of its pereiopods, being large paddle-shaped organs, terminated by a very small end-joint. Both have got, like *Amphion*, a central (Nauplial) eye and eight pairs of branched legs; but their body is more *Sergestes*-like and less flat than that of *Amphion*. They certainly belong both to the same genus, and may be called *Amphiones* until more than one specimen of each has been obtained.

"To me these Amphionidæ are especially interesting, as I can compare them with the larvæ of *Sergestes* and *Leucifer*, the former of which have also got eight pairs of branched legs and the central eye which persists in the Amphionidæ.

"There are good reasons for the statement that the larvæ of *Leucifer* and *Sergestes* pass through an *Amphion* stage; and this, it seems to me, throws a good deal of light on the relations and systematical position of *Amphion* itself.

"Dohrn, to whom we owe so many fine discoveries concerning the pelagic Crustacea, has described,[1] under the name of *Elaphocaris*, a small and very spiny *Zoëa*, caught in the harbour of Messina. He calls it the larva of a Decapod without fixing its position. This small larva was often seen by me in the Atlantic; but I only lately found out that *Elaphocaris* is the larva of a species, or rather of some species, of *Sergestes*. There is, however, one species of this genus in which the *Zoëa* is not an *Elaphocaris*, but a larger, less spiny form, similar, however, in all other respects to the former. Of the species which develops with an *Elaphocaris*-stage in the Western Pacific, I have collected numerous specimens of all the stages, from the youngest Zoëas up to the mature animal. The mode of development is very simple. After the first moulting the larva gets six more branched legs and loses many spines. It enters the *Amphion* stage, then moults, throws the branched legs off, gets branchiæ, and becomes a young *Sergestes*. Only after this last moulting the central eye, hitherto present, disappears.

[1] *Zeitschr. f. wiss. Zool.*, Bd. xx. p. 662, tab. 31, fig. 28.

"And very similar to that of *Sergestes* is the development of *Leucifer*. Here the earliest *Zoëa* of a species from the Western Pacific has at first no eyes, then sessile ones come out, and the animal then presents the form which Dana has called *Ericthina demissa*, and which Claus suspected to be not a Stomatopod but a Schizopod larva. After the second moulting this *Ericthina* gets stalked eyes and very long setæ on all its appendages, becoming a rather long, very delicate *Zoëa*. It now enters the *Amphion* stage, but never gets more than four pairs of pereiopods, and loses another pair of these when it moults for the youngest *Leucifer* stage, in which two pairs of pereiopods are absent.

"The next question, after having found this out, was, of course, whether *Amphion*, *Sergestes*, and *Leucifer*, leave the egg as a *Zoëa*, or whether there is a preceding *Nauplius* stage. My own impression is that in the two first-named genera this is not the case, as the youngest Zoëas which I caught had all the same size, and as none of them was without the large lateral stalked eyes. As for *Leucifer*, the question appears to me to be doubtful;[1] for it is, from what I have seen, quite possible that my youngest *Zoëa*, which has only got a central eye, may be preceded by a *Nauplius*. Of course the simplest thing would be to get the eggs; but there is the difficulty, for *Amphion* is caught very rarely, and has never been obtained at any other time but between 8 and 12 P.M., when it is extremely difficult by lamp-light to find out the youngest stages. *Sergestes* larvæ are commoner, appearing also in the day-time, and *Leucifer* is sometimes caught in abundance. I hope, therefore, that I shall succeed in completing my researches about this question, especially as far as the latter two genera are concerned.

"H.M.S. 'Challenger,' Honolulu, Sandwich Islands, July 30, 1875."

Petalidium,[2] Spence Bate.

Petalidium, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 194, 1881.

External tissue membranous. Carapace about one-third of the length of the animal, dorsally elevated above the frontal region to a laterally compressed crest, and anteriorly produced to a small point. The cervical fossa is well defined. The rest of the animal is smooth. Pleon with the somites subequal, the fifth being a little shorter than those anterior to it, and the sixth somewhat longer.

The ophthalmopoda are uni-articulate, long, subcylindrical, and slightly compressed, and stand upon their own somite, which projects between them in advance of the frontal margin.

First pair of antennæ with the first joint excavated on the upper surface, and

[1] This has since been cleared up by Professor Brooks (*Phil. Trans.*, pt. i. p. 57, 1882), who has shown that the brephalos of *Leucifer* is in the Nauplius-stage.

[2] πεταλίδιον, a small leaf.

furnished with a short, obtusely pointed stylocerite (the rest of the appendage is destroyed).

Second pair of antennæ carries a large scaphocerite but no ancecerite (the flagellum is lost).

The epistoma is thin, membranous and lunate.

The cheiloglossa is large, curved and wide.

The mandibles are deeply placed within the oral aperture, and have the psalistoma smooth and continuous with the molar process, at the base of which a long, two-jointed synaphipod exists.

The first pair of siagnopoda is three-branched, the second four-branched, and carries a mastigobranchial plate, the third is three-branched, the inner branch being broad, foliaceous and biarticulate, and fringed with hairs upon the inner side, the second or middle branch long, slender and triarticulate, and the third or outer long, slender, tapering, and free from hairs.

All the other appendages except the pleopoda are too much broken to allow their form to be determined.

The telson, which is perfect, is long, slender and tapering, but not so long as the lateral plates of the rhipidura, which are broken off in all our specimens.

Geographical Distribution.—Only one species of this genus is known, and that was taken in two localities, one near Marion Island and the other south of Australia.

The great distinction between this genus and *Sergestes* exists in the form, character, and arrangement of the branchial plumes, which consist of a series of plates and cylindrical filaments situated side by side in a series of rows at right angles to the stalk. There is but one plume to each of the five anterior somites of the pereion, the posterior two somites having none; between some of the somites is a large foliaceous plate. The arrangement may be tabulated thus :—

Pleurobranchiæ,	.	.	.	...	...	f	f	f	...	...
Arthrobranchiæ,	.	.	.	r	1	1	1	1	...	...
Podobranchiæ,	.	.	.	1	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	1	...	...	...	...	...	...
				h	i	k	l	m	n	o

Petalidium foliaceum, Spence Bate (Pl. LX.).

Petalidium foliaceum, Sp. B., *loc. cit.*, p. 194.

Anterior margin dorsally elevated to a small, laterally compressed crest, produced in front to a very small point; body generally smooth. Ophthalmopod subcylindrical, long; ophthalmus not broader than the diameter of the stalk, furnished on the inner side with a small tubercle, close to the dark pigment. Dark brown hairs on the oral

appendages. Synaphipod reaching beyond the extremity of the peduncle of the second pair of antennæ.

The rest of the animal is so damaged that it is difficult to give a specific description.

Habitat.—Station 146, December 29, 1873; lat. 46° 46′ S., long. 45° 31′ E.; near Marion Island; depth, 1375 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·6. Four specimens, females. Trawled.

Station 159, March 10, 1874; lat. 47° 25′ S., long. 130° 22′ E.; south of Australia; depth, 2150 fathoms; bottom, Globigerina ooze; bottom temperature, 34°·5. One specimen, female. Trawled.

This species, so far as it can be determined from the damaged specimens in the Challenger collection, is very like *Sergestes japonicus*, but it may be very readily discriminated by the dark brown colour of the hairs attached to the margins of the synaphipod and other oral appendages.

The nervous system in one specimen being in a tolerably good state of preservation, I was enabled to lay it bare in its entire length from the cephalon to the extremity of the pereion.

The cephalic lobes are very large and apparently divided into lobules, corresponding to the branches that are given off. The ophthalmic branch is very small and thread-like, while that which supplies the first pair of antennæ is very large, strong, and originates in a special ganglion in front of, but belonging to, the cerebral mass, while behind, from the largest mass, two stout nerves, independent of each other, lead to the second pair of antennæ, one apparently going to the green gland, and the other to the antennæ or antennal muscles, which are exceptionally strong. The oral branches of the nerves are small and arise from the œsophageal loop, while all the limbs attached to the pereion are supplied from the ganglionic masses on the ventral surface in the following manner. The anterior two ganglia supply the gnathopoda. The three next supply the corresponding pairs of pereiopoda, of which the posterior is connected with, and supports, the oviducts, and is a slightly larger ganglion than the preceding; the central cord at this point divides into two, and reunites at the next ganglion, which sends off two branches to the penultimate and two to the ultimate pairs of pereiopoda, after which the central cord becomes single as it traverses the median ventral line of the pleon; consequently there is no ganglion corresponding with the posterior pair of pereiopoda.

Sergestes, Milne-Edwards.

Sergestes, Milne Edwards, Ann. d. Sci. Nat., ser. 2, vol. xix. p. 346, 1830.

Body long and slender. Structure submembranous. Carapace scarcely produced to a rostrum anteriorly. Ophthalmopod single-jointed.

The first pair of antennæ is long and slender, having the peduncle long, without prosartema or stylocerite, terminating in one long, slender flagellum, and a short rudimentary one, which in the male is frequently furnished with a small tertiary branch, while the large flagellum becomes bulbous at the base, and supports a fasciculus of membranous cilia.

The second pair of antennæ is long and extremely slender, and carries a large scaphocerite. The mandibles have the incisive margin smooth, and carry a long and narrow two-jointed synaphipod; the other oral appendages correspond to those of *Gennadas* and *Benthesicymus*.

The first pair of gnathopoda is large and very robust, being generally reflexed upon itself, but not closely so, and terminates in a short blunt dactylos. The second pair is long, slender, and feeble.

The first pair of pereiopoda has only six joints, the dactylos apparently being absent. The second and third pairs of pereiopoda are long and slender, terminating in minute chelæ. The fourth and fifth pairs are short and feeble, and terminate in simple dactyli. The pleopoda are biramose, except the first pair, which carries a petasma attached to the basal joint in the male and which becomes rudimentary in the female. The posterior pair of pleopoda is modified to form the rhipidura, and is much longer than the telson.

This genus was first established by Professor Milne-Edwards, in November 1829, in a paper read before the Academy of Sciences upon a species taken in Mid-Atlantic. It has since been more fully elucidated by Kröyer in a monograph published in 1856,[1] in which he has modified Milne-Edwards' description by showing that the pereiopoda, which Milne-Edwards says are "filiformes et monodactyles," are not so. The second and third pairs, when examined with a lens of low magnifying power, are seen to be minutely chelate, and the others appear to be wanting in a joint; and the gnathopoda have an increased resemblance to a pediform character, the first pair being the most powerful of all the appendages.

The general appearance is that of a depauperised Penæiform Crustacean, and the condition of the branchial organs supports this idea. These consist of a single row of branchial plumes, which, in accordance with the nomenclature that I have used, are all pleurobranchiæ, but the posterior plume, instead of being attached to the somite that carries the posterior pereiopod, is attached to the penultimate somite, which consequently carries two plumes.

Thus there are seven plumes connected with six somites, which are arranged as follows. The first pair of gnathopoda carries a small, circular, discoid mastigobranchial plate, which calls to remembrance the form of the branchial appendage in the Amphipod

[1] Forsög til en monographisk Fremstilling af Kræbsdyrslægten Sergestes. *K. dansk. Vidensk. Selsk. Skriv.*, Bd. iv. p. 217, Copenhagen, 1855; *Zeitschr. d. gesammt. Naturwiss*, vol. viii. p. 413, Halle, 1856.

Crustacea, with which Milne-Edwards says the species of this genus establish a connection. Attached to the mastigobranchial plate is a well-developed but small podobranchial plume. Between this and the next somite, deep in the interstitial groove, is a small foliaceous plate of a low degree of structure; on the somite that carries the second pair of gnathopoda is a larger branchial plume, which has no connection with the gnathopod or its membranous articulation; this is followed by an interstitial foliaceous plate on the three following somites; on the last somite the foliaceous plate is wanting, but a second branchial plume is present besides the normal one, while the last somite has neither plate nor plume.

The arrangement,[1] as seen in *Sergestes japonicus*, is as follows :—

Pleurobranchiæ,	...	*fl*	*fl*	*fl*	*fl*	2	...
Arthrobranchiæ,	...	...	...	...	...	...	...
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	1	...	...	...	...	...	...
	h	i	k	l	m	n	o

In *Sergestes kröyeri*, however, there are two branchiæ attached to the penultimate somite, two to the antepenultimate, an interstitial foliaceous plate between the next three somites, and one branchial plume but no interstitial leaf between the next. This may be better understood by the following tabular arrangement, by which it may be seen that one foliaceous plate has been replaced by a branchial plume.

Pleurobranchiæ,	...	*fl*	*fl*	*fl*	2	2	...
Arthrobranchiæ,	...	...	...	...	...	...	...
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	1	...	...	...	...	...	...
	h	i	k	l	m	n	o

In *Sergestes prehensilis* this feature is carried a degree still further, inasmuch as the interstitial foliaceous plates exhibit signs of breaking up into branchial plumes, too unimportant to be pronounced plumes, and too much differentiated to be called foliaceous plates.

Thus it appears that these interstitial foliaceous plates are rudimentary branchial organs.

Geographical Distribution.—The species of this genus are chiefly oceanic, and have been taken all over the globe, in the Arctic as well as in the Tropical seas.

[1] Claus in his Morphologie der Crustaceen (p. 52) has tabulated the branchiæ of *Sergestes* in accordance with the table given on this page for *Sergestes japonicus*, with the exception that he makes the foliaceous plates in his diagram (Taf. iii. figs. 31, 2*c*, 3*c*, 4*c*, 5*c*), which he has figured as large as those in the genus *Petalidium*, as well as the antepenultimate (6*c*), and ultimate (7*c*) plumes, to correspond with the arthrobranchiæ, and the other branchial plumes (*c'*) to homologise with the pleurobranchiæ; but, according to my observation, none of the branchiæ are attached to the membranous tissue that unites the coxæ of the pereiopoda to the somites of the pereion.

Development of Sergestes.

Our knowledge of the development of this genus is still imperfect, although it is the result of the examination of numerous specimens obtained at different times by different persons, of their comparison with one another, and of deductions drawn from the general appearances of the animals and the relative proportions of their parts.

As in all the species of this order, the brephalos, or the organism as it first issues from the ovum, is unknown. The ovum is most probably deposited in the sea and hatched in the warmer waters of the ocean.

In the genus *Leucifer* Professor Brooks has fortunately been enabled to procure some ova, which he found not united to the parent, as they generally are in the higher Crustacea, by means of organic tissue attaching them to the pleopoda, nor carried in pouches, or in ovisacs, as in *Mysis*, *Gammarus*, &c., but rather as if they were entangled amongst the pereiopoda and cohering to one another.

The youngest form that we know is that shown in the annexed figure (fig. 49) taken from the drawing of Dr. v. Willemoes Suhm.

"Zoea of *Sergestes*, × 244[1] nat. size, just hatched, H $\frac{1}{7}$, 28 August, 1875, in the 10 of Latitude, on the passage from Hilo to Tahiti.

"Length of the abdomen,	0·21 mm.
Length of the carapace, without spines,	0·35 „
Length, entire,	0·56 „
Greatest breadth of the carapace,	0·38 „
Length of a^1,	0·7 „

"First antennæ four-jointed at the base, which disappears later.

"*oc.* The early formation of the eye; right and left of the deeply situated Nauplius eye. Mandibles apparent; first maxillæ and labium not visible and perhaps not yet formed, although the palpus of the first maxilla is very distinct, as also the second maxilla, maxilliped, and gnathopod. When the yolk mass in the interior does not hide anything one observes some grain-like substance with bright bladders between. The posterior spine of the carapace does not go exactly straight backwards but upwards. The rostrum is certainly wanting."

The above are the notes made regarding this specimen by Dr. v. Willemoes Suhm, after whom I have named it.

Elaphocaris suhmi.

It differs from all other specimens at this stage in the absence of a rostrum, which is generally so persistent a feature. The great fronto-lateral spinous processes are remarkable for their length, and still more for being biramose, the division commencing at

[1] From which our figure, for convenience, is reduced one-third, or to about 163·3.

about a third of their length from the base, and these long processes are armed from base to summit with short teeth or spines, on both sides on the basal undivided portion, and on one side on the branches. The frontal margin between them is concave. The lateral margin between these spinous processes and the postero-lateral ones is also

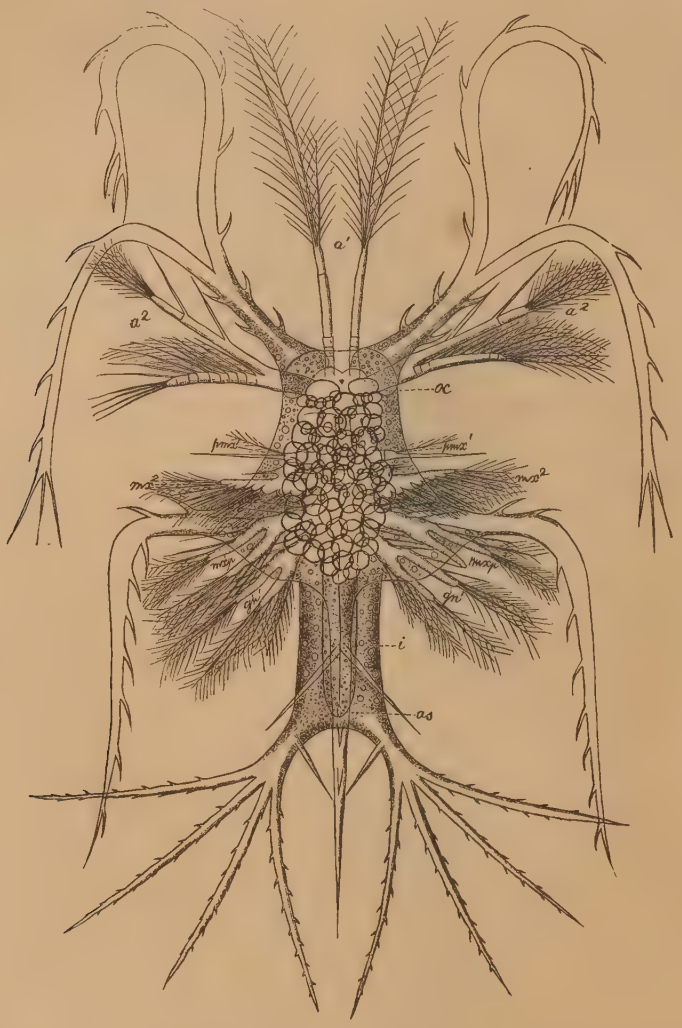

FIG. 49.—*Elaphocaris suhmi*. a^1, first pair of antennæ; a^2, second pair of antennæ; *oc*, incipient ophthalmopod; pmx^1, first pair of maxilla; mx^2, second pair of maxilla; *mxp*, maxillipedes; gn^1, first pair of gnathopoda; *i*, intestinal canal; *as*, anal foramen.

concave, sweeping gradually backwards and projecting outwards on each side to a long single spinous process, which is armed near the base on its frontal margin with two, and beyond this, on its posterior margin, with several short sharp teeth, similar to those on the anterior spines. From the base of these processes the margin of the carapace slopes

convexly inwards and backwards to the median line, whence a long and slender spine of like appearance and similarly armed projects upwards and backwards. The long spinous processes, judging from Suhm's drawing, appear to be flexible, and were probably bent or arranged in the positions in which they are represented for the convenience of being placed on the paper.

The pleon is shorter than the carapace and not segmented. It terminates by bifurcating into two narrow, widely separated lobes, each armed with four long, denticulated, terminal spines or processes, and a short smooth one on the inner side at the base pointing obliquely inwards and backwards.

The ocellus is visible between the antennæ, and Suhm says that the ophthalmopoda (*oc*) are visible in an incipient condition to the right and left of the nauplian eye (ocellus).

The first pair of antennæ (a^1) is four-jointed, the terminal joint supporting two long and one shorter ciliated hairs.

The second pair of antennæ (a^2) is biramose, the anterior branch, respresenting the flagellum in the adult, is two-jointed, and supports a scaphocerite, which in this stage is multiarticulate and fringed with ciliated hairs on one side and at the extremity, the outer side being smooth and free from hairs.

The mandibles are visible, and figured in the annexed cut, as well as the first and second pairs of maxilla, at pmx^1 and mx^2, as also the maxilliped *mxp*, and the first pair of gnathopoda gn^1. The second gnathopod is absent, and all are fringed with long ciliated hairs; posterior to these no appendage is present.

The specimen from which this drawing was taken appears not to have been preserved, and I only know it from Suhm's drawing. It was but little more than half a millimetre in length, and Suhm is most probably correct in believing that it had only recently been hatched, the presence of the yolk-mass clearly demonstrating its immature condition, but the long and plumose cilia are evidence that at least one moult had elapsed after it quitted the ovum. In this stage the ophthalmopoda are not developed, and no appendages are present posterior to the first pair of gnathopoda, and there is no evidence, except the embryonic condition of the ophthalmopoda, that shows any distinction between this Elaphocaris and the Zoea of a Brachyurous Crustacean.

The next stage of which we have any knowledge was taken on the 13th of March, 1875, at or near Station 221, in lat. 0° 40′ N., long. 148° 41′ E., north of the Admiralty Islands in the Pacific. It is labelled "Sergestes zoëa, Elaphocaris" by Willemoes Suhm, and is given on Pl. LXI. fig. 1. It is about 1·5 mm. in length, from the extremity of the rostrum to the middle of the caudal cleft, and evidently belongs to a species different from Suhm's previous specimen, since it has a long spinous rostrum. The ophthalmopoda are well developed, but no appendages posterior to the gnathopoda are present, and even these are in an immature condition.

The carapace is dorsally nearly circular, somewhat pointed posteriorly, and armed

with four compound spinous processes. The anterior forms the rostrum and is about as long as the carapace, and supports on each side and along the dorsal surface a series of about nine or ten long, straight, spine-like processes, besides two or three small teeth at the extremity. Two, one on each side, spring from the lateral surface in a line slightly posterior to the mandibles; these also carry seven or eight long, straight, spine-like processes; the fourth is produced posteriorly as a long, straight, spinous process directed backwards, and is armed with four long spines, two on each side near the base, the anterior pair directed outwards, upwards, and backwards, and the posterior horizontally outwards.

The pleon does not project posteriorly beyond the carapace for more than half the length of the latter, and it carries no appendage.

The telson is widely forked, each ramus being broad, flat, and armed with four long and two short spines. On the outer and anterior side of the base of the telson there is on each side one strong, straight tooth of moderate length, and on the distal extremity of each ramus are four very long spine-like processes, the posterior three terminally serrate, that appear to be flexible in character, and on the inner side, pointing diagonally towards each other, is another short curved tooth or spine.

The ophthalmopoda are well developed, pedunculated, pyriform and robust, the ophthalmus being slightly larger than the distal extremity of the stalk. They stand on an advanced projection of the cephalon that forms the base of the great rostral process, and their length is about one-third that of the carapace.

The first pair of antennæ is four-jointed; the terminal joint, which represents the future flagellum, is narrower than the preceding one, of about the same length as the third joint, and terminates in three long, slender hairs.

The second pair of antennæ is biramose; the inner branch, which is nearly as long as the peduncle of the first pair, is smooth on one side and fringed with hairs on the other, and homologous to the scaphocerite; the outer branch is three-jointed and homologous to the two terminal joints of the peduncle and rudimentary flagellum.

The epistoma is armed with a long, straight, spine-like process which reaches as far forwards as the origin of the ophthalmopoda.

The mandibles consist of two large, robust organs, that even at this stage approach in appearance those of the adult; behind these there are probably two pairs of appendages, but I have not been able to determine them with certainty.

The pereiopoda are not yet visible even as buds.

The organism as it now appears is that of an early Zoea—I say early, because the gnathopoda are not yet discernible at this stage.

The next stage, but of which there is no specimen in the Challenger collection, is one closely resembling the last, and is figured by Claus in his Crustaceen System (Tab. v.

fig. 1). It evidently belongs to a species closely allied to the last, but is a little more advanced. It is 1·33 mm. in length, and the description I have given above will also do for this, except in the case of the appendages.

The ophthalmopoda are large and fungiform, the eye being very broad and the stalk slender.

The first pair of antennæ is single-branched, multiarticulate at the base, and terminates in a slender articulus that carries three fine hairs.

The second pair of antennæ is biramose, each branch terminating in three or four long hairs.

The epistoma is armed with a long spine or tooth that projects forwards, but does not reach to the base of the ophthalmopoda.

The oral appendages and gnathopoda are developed; the animal has reached the true Zoea stage, and there is nothing in its appearance or characters excepting the biramose condition of the second pair of antennæ that is sufficient to prove that it does not belong to one of the Brachyura. Several transverse lines, posterior to the carapace, define the position of the future somites, but no appendages even in the most incipient stage are visible.

Anton Dohrn,[1] to whom we are indebted as having been the first to discover and describe this remarkable form of Crustacean life, gives in his researches on the structure and development of the Arthropoda, the figure of a specimen taken off Messina during the month of March, which bears a general resemblance to that of the Challenger specimen represented on Pl. LXII., but differs in certain details that are suggestive of a distinct specific origin. The rostrum is smooth and free from spinous adornments The orbital, lateral, and posterior dorsal processes of the carapace are furnished with long smooth spines, the extremities of which are tipped with three radiating teeth, except the central, which is armed with a series of small lateral teeth, but only on one side.

The carapace is contracted immediately behind the orbital processes, and enlarged in a line continuous with the lateral margins.

The somites of the pleon are short and broad, and the caudal fork is armed with six long spines, corresponding in number and position with those of Claus's figure, which possesses one more than that on our specimen.

The ophthalmopoda are long and have the ophthalmus of not much greater diameter than the stalk, and stand in the same line beneath the orbital processes.

The first pair of antennæ is four-jointed, and terminates in a few simple hairs.

The second pair is two-branched, the branch representing the scaphocerite being multiarticulate and fringed on one side with long hairs.

The rest of Anton Dohrn's description and figure corresponds with the degree of development shown in our specimen, excepting that the saccular sixth pair of pleopoda is shorter.

[1] Untersuchungen über den Bau und Entwickelung der Arthropoden, von Dr. Anton Dohrn. Zweites Heft, mit viii. Tafeln. Leipzig, 1870.

The next stage in the progressive life-history of the animals in this genus is that given in the annexed cut (fig. 50), from a drawing by Willemoes Suhm.

The following are Suhm's notes attached to his drawing :—

"Length of rostrum,	0·98 mm.
„ carapace,	0·98 „
„ pleon,	0·73 „
Entire length,	2·7 „
Length of ophthalmopoda,	0·35 „
Greatest breadth of carapace,	0·87 „
Length of lateral spinous processes,	0·31 „
Length of posterior do.,	0·70 „

"Taken 25 August 1875. Lat. 12° 42′ N., long. 152° 1′ W. South of the Sandwich Islands.

"At the next succeeding moult the great posterior process is divided into two, so that the Zoea has three of these processes on each side, after which the third Amphion-like larva is produced.

"The points on each side of the abdominal segments project considerably. It is only by destroying the animal that we can get any knowledge of the pereiopoda or their development.

"After the second moult come the later forms of larva."

It differs from his previous figure in having a long rostrum, distally serrate at the margins, and dorsally armed at the middle with a long, slender, solitary spine, posterior to which the margins are smooth. The carapace is circular or nearly so; it is furnished external to the orbital angle, on each side of the frontal margin, with a large spinous process. On the lateral margin, in a line with the oral apparatus on each side, is a large spinous process; and in the median line of the posterior margin is a long dorsal spine, armed on each side with two lateral spines and dorsally with two, and having the distal portion laterally serrate.

The ophthalmopoda are fungiform and the antennæ are well developed.

The first pair of antennæ consists of one long and one short joint, distally furnished with three or four long ciliated hairs.

The second pair is biramose, a basal joint supporting an inner biarticulate branch which consists of one long and one short joint tipped with three or four long ciliated hairs, and a second multiarticulate branch, that represents the scaphocerite in the adult; it is smooth on one side and on the other furnished with many long plumose hairs.

The oral appendages are also present, and the epistoma is armed with a long spine-like tooth that reaches beyond the frontal margin.

The mandibles are present and the incisive margins are serrate.

The maxillipedes and gnathopoda are furnished with long plumose hairs.

The pereiopoda are present as long saccular buds, and their biramose character is visible.

The figure represents a dorsal view, and none of the pleopoda excepting the posterior pair is shown, and this consists of two long, narrow, cylindrical, tubular appendages of membranous appearance. These are directed laterally outwards and then curved forwards. The telson is biramose, each branch being furnished with five stout divergent spines, four of which are serrate at their extremity.

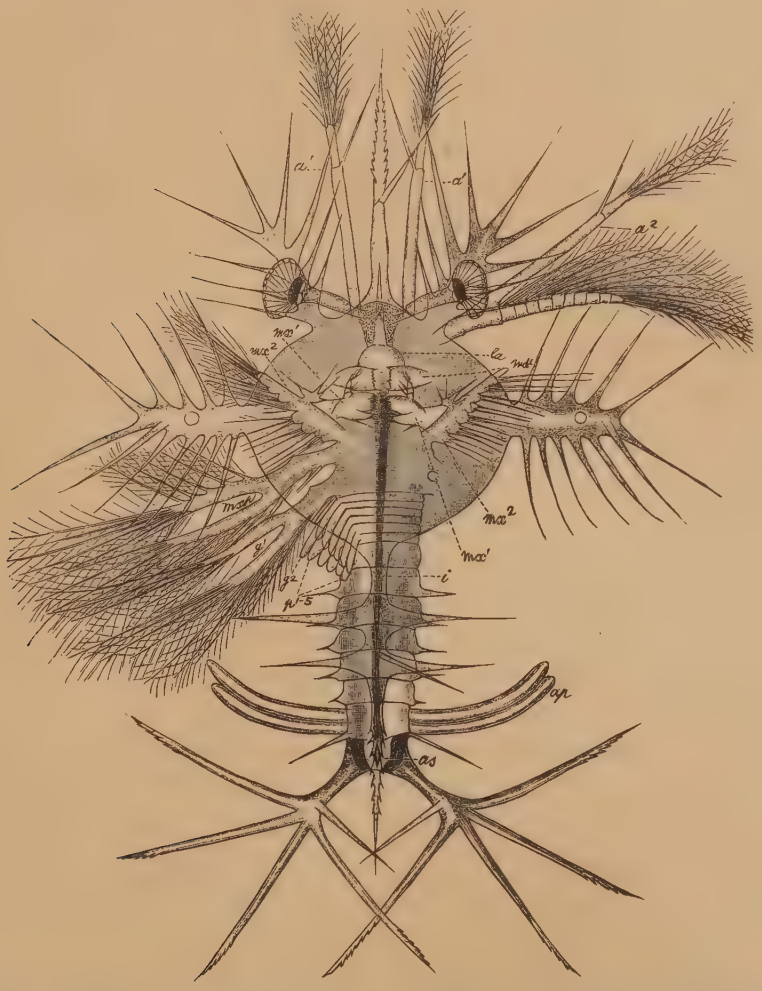

FIG. 50.—*Elaphocaris*—Sergestes. a^1, First pair of antennæ; a^2, second pair of antennæ; *la*, labium; *mdb*, mandibles; mx^1, first pair of maxilla; mx^2, second pair of maxilla; *mxp*, maxillipede; g^1, first gnathopod; g^2, second gnathopod; p^{1-5}, five pairs of pereiopoda; *i*, intestinal canal; *ap*, posterior pair of pleopoda; *as*, anus.

Although the drawing made by Suhm differs in some details from that given by Claus (pl. vi. fig. 1, &c.), I think it must be recognised as showing a younger moult of the same or some closely allied species.

Some of the differences in the details, notably those relating to the rostrum and to

the arrangement of the spines on the posterior dorsal process of the carapace, are probably due to the more or less perfect display of the specimen; but there is one structurally important part that is essentially different, and demonstrates the specimen to be of a younger stage. For, in our figure of the next stage, as well as in that given by Claus, the two large spinous processes on the frontal margin, one on each side of the rostrum, are projected forwards on a process of the carapace, and the ophthalmopoda are implanted behind them, whereas in the figure given by Suhm the frontal spinous processes are represented as being external and posterior to the ophthalmopoda, and the frontal margin of the carapace does not project; an evidence of its younger condition.

The next stage we know is that given on Pl. LXII. of this Report, and agrees closely with that figured by Claus, which represents the ventral surface, whereas ours gives the dorsal, but the appendages are shown through the transparent integument so as to indicate their relative positions.

It is difficult to believe that this is a further development of the same animal, inasmuch as there are two large spinous processes thrown out at the base of the rostrum and anterior to the ophthalmopoda. Our specimen has two spines less on the telson than are given in Claus's figure, but in all other details they resemble each other, and are probably the young of very closely allied species.

The carapace is nearly circular, with the cephalic region considerably advanced and projecting forwards, and furnished with a central spinous rostrum and two lateral spinous processes. The rostrum is about half the length of the carapace and armed with two lateral spines opposite each other and directed obliquely forwards, and two on the upper surface, in a line one before the other. The lateral spinous processes at the base of the cephalic lobe much resemble those at the lateral margin, and are directed obliquely forwards, and covered with long spines pointing in every direction; I counted fourteen or fifteen on each. The depression formed between the base of these processes and the antero-lateral margin of the carapace, forms the orbital notch in which the ophthalmopod is situated. The lateral spinous processes are opposite each other in a line posterior to the mandibles, each is armed with very long spines, of which I counted fifteen, the one at the apex carrying a small hook at its side, somewhat distant from its apex, and three at the base are on the dorsal surface. The posterior spinous process is long, straight and slender, and reaches beyond the extremity of the telson; it is armed with eight long spines, two of which at the base on each side are directed obliquely upwards and forwards; two a little posterior pass laterally outwards, two on the under side, still more posteriorly, are directed obliquely downwards and forwards, and two from near the same point of origin are directed obliquely downwards and backwards.

The pleon is armed on each side of the posterior margins of the five anterior somites, with a long spine-like tooth passing outwards and probably downwards. The telson is

bilobed, each lobe being long, flat, and armed with five long and strong spines, those on each side of the base being directed forwards, and four radiating from the terminal surface of each lateral lobe.

The ophthalmopoda are fungiform, the stalk being slender and the eye broad, and broader anteriorly than posteriorly.

The first pair of antennæ (*b*) is three-jointed, the basal joint having the greatest diameter, the second being the longest, and the third the shortest and most slender; each is furnished with a hair or two, the third terminating in three long and two short subapical hairs.

The second pair of antennæ (*c*) is biramose. The basal joint is nearly as broad as long, and supports two rami, of which the longer is two-jointed, the first joint being long, slender, and free from hairs, excepting one on the inner distal extremity, and represents the future terminal joint of the peduncle, and the second is short, slightly tapering, and tipped with two long hairs; this joint represents the future flagellum. The shorter branch is as long as the first joint of the inner branch, it is also free from lateral hairs, but bears five long ones at its tip. This branch represents the scaphocerite of the permanent organ.

The mandibles I have not been able to determine, but they appear to have no synaphipod.

The maxillæ are also unknown to me except as viewed while attached to the animal.

The third pair of siagnopoda (*g*), or maxillipedes, consists of a six-lobed branch; each lobe increases in size posteriorly and is furnished with three or four strong hairs, as is also the distal extremity of the appendage, which gradually tapers to a point. The outer or convex margin supports a flattened lobe and is furnished with five or six long fine hairs.

The first pair of gnathopoda (*h*) is biramose; the basal joint is broad and supports the two branches, of which the inner is five-jointed, and supports a fasciculus of ciliated hairs at the inner distal extremity of each joint, while the outer surface is smooth; the outer branch is single-jointed, nearly as long as the inner, and furnished along both margins with a few isolated, ciliated hairs.

The second pair of gnathopoda resembles the first in its general details.

The first pair of pereiopoda is biramose, one branch being a little longer than the other; the longer is furnished with two long hairs at the extremity, while the shorter is free from any.

The succeeding pairs of pereiopoda are in a more immature condition, and in our specimen consist of three pendulous saccular appendages, whereas in Claus's figure they are longer and biramose, but still in a bud-like condition.

The pleopoda are all wanting, except the sixth or posterior pair, which are large and

considerably advanced in development, and are with the second pair of antennæ the only appendages that demonstrate the Zoea to be of Macrurous origin. They consist of a short basal joint and two unequally long, membranous branches directed outwards, downwards and forwards, and implanted at a distance from the terminal portion of the forked telson, which is not defined from the preceding somite.

Length, 2 mm. (0·08 in.).

Habitat.—South Atlantic, March 1 to 4, 1876; lat. 32° S., long. 45° W.; between Monte Video and Tristan da Cunha.

This is as far as we are able to trace the changes in the Elaphocaris of the same or of closely allied species.

Elaphocaris crassus, Willemoes Suhm, MS. (Pl. LXI. fig. 4).

This is another specimen which has been found in the Pacific. It differs in form in certain parts, particularly in the character of the spiny processes, which appear to show that it belongs to another, but in all probability more or less closely allied genus.

The carapace dorsally is nearly circular; the anterior central extremity is produced to a long rostrum, about two-thirds the length of the carapace; it is straight and tapers to a point, having the margins fringed with short sharp spinules. On each side of the base of the rostrum there is a long, curved, anteriorly-directed, spinous process, smooth on the inner side and armed on the outer with six long spines. The lateral spinous processes consist of one long central spine, armed towards the apex with small denticulations, while near the base there stand two anterior and three posterior long, blunt, and rather flexible spines. On the posterior margin of the carapace on each side of the pleon is a broad lobe or tubercle crowned with five or six long, blunt-pointed, finger-like, subflexible spines, but in the median line there is no spinous process as in other species.

The pereion in this specimen is developed and exposed posteriorly to the carapace.

The pleon has the five anterior somites subequal, and armed on each side with a long, slender, sharp spine.

The telson is large, bilobed, and armed with seven very long semiflexible spines. The most anterior is the smallest and most slender, and stands on each side not far from the posterior pair of pleopoda. The five succeeding are very long, flexible, and slender, and beyond these on the inner side is the last, that points diagonally backwards and inwards.

The ophthalmopoda are fungiform, the ophthalmus being much broader than the stalk.

The first pair of antennæ (*b*) is single-branched, four-jointed, and free from hairs, except the terminal joint, which is tipped with two long hairs and subapically with two short ones.

The second pair of antennæ (*c*) consists of a basal joint that supports two branches one of which is two-jointed, the first joint being long and cylindrical, the second short, more slender, and tipped with four long hairs; the other branch is also cylindrical, multi-articulate, and fringed with hairs, one being attached to each articulus on the outer side.

The labrum is armed with a long tooth or spine directed forwards and reaching beyond the frontal margin.

The mandibles and oral appendages I have not been able to determine in this unique specimen, but they, as well as the two pairs of gnathopoda, are present.

The pereiopoda are still in an undeveloped condition, existing as long, narrow, saccular processes.

The pleopoda are not yet present, except the posterior pair, which consists of a basal joint that supports two subequal membranous branches.

Length, 1·5 mm. (0·06 in.).

Habitat.—The Pacific Ocean.

April 3, 1875; lat. 25° 0′ N., long. 137° 50′ E.; south of Japan, between Stations 229 and 230.

Platysacus crenatus,[1] n. gen. et sp. (Pl. LXIII.).

This form of Elaphocaris must, I think, belong to a very distinct species, and for the sake of convenience I propose to call it *Platysacus crenatus*. It differs from all the others in having a series of crenated or small tooth-like points crowning each of the ten lobes which are disposed around the margin of the carapace, and the dorsal surface is covered with eleven long spine-like teeth.

The rostrum is straight, free from ornamentation, and reaches a little beyond the ophthalmopoda. On each side of the frontal margin, corresponding with the outer canthus of the orbit, is a long spine-like tooth, subequal in length to the rostrum; posterior and a little external to this, within the margin, and standing on the antennal region, is another long spine-like tooth, and on the outer antennal angle is a broad flat lobe, directed obliquely outwards and upwards, and crowned with nine or ten fine points or teeth. Posteriorly, on the lateral margin, and corresponding with the line of the oral cavity, is another broad flat lobe of extreme tenuity, the margin of which is fringed with a series of ten or twelve fine, sharp, tooth-like points; within this on the dorsal surface, in a line with the oral organs, are two long and distinct spine-like teeth; posteriorly, on the lateral margin, are three more broad, flat, delicately thin lobes, crowned with numerous small tooth-like points, varying from six or seven to twelve or more, the posterior standing laterally to the median line of the carapace. In a transverse line corresponding to the anterior portion of the third or middle marginal lobes, there stand

[1] From πλατύς, flat, and σάκος, shield.

three long spine-like teeth, one in the median line of the carapace, and one on each side of it; they are directed upwards and a little backwards.

The pereion has five somites developed, visible posteriorly to the carapace.

The pleon has the five anterior somites subequal in length; each is armed with a central dorsal tooth on the posterior margin, and a large lateral spine-like tooth at the postero-lateral angle. The sixth somite is longer than the two preceding ones together, and is armed on each side at the postero-lateral angle with a long spine-like tooth.

The telson is bilobed, each lobe is long, flat, and armed with a series of eight teeth radiating from the margin.

The ophthalmopoda are short, stout, and pyriform, but not much longer than broad, and about one-fourth the length of the carapace.

The first pair of antennæ is one-branched and four-jointed; the first joint is the longest and is furnished with a ciliated hair on the one side and a small hair on the other; the second is about two-thirds the length of the first and similarly armed on each side at the distal extremity; the third is a little shorter, more slender than the second, and is similarly armed, except that it has two ciliated hairs instead of one, and the fourth joint is more slender than the preceding and is tipped with three ciliated hairs.

The second pair of antennæ consists of a broad basal joint, which supports another not quite so broad, that in turn supports two branches, the inner of which has three joints, two of which are distally armed on the inner side with a projecting point bearing two long ciliated hairs, and the terminal joint supports six. The branch on the outer side becomes the future scaphocerite, and is flat, broad, and multiarticulate; the outer margin is unarmed except for one small hair near the middle, but the inner margin including the distal extremity is furnished with nine or ten long ciliated hairs.

The oral appendages are not easily detected, as the specimen being unique is mounted for the microscope, and I hesitated to dismount it.

Four pairs of pereiopoda are distinctly visible; each consists of a strong basal joint that supports two equal, flat and narrow plate-like appendages tipped with two small hairs.

The pleopoda are not yet visible even as buds, except the sixth pair, which is large and well developed, consisting of a short basal joint armed with a long spine-like tooth and bearing two long foliaceous rami, the external of which is tipped with five long ciliated hairs and the inner with two.

Length, 3 mm. (0·12 in.).

Habitat.—Station 352, April 13, 1876; lat. 10° 55′ N., long. 17° 46′ W.; on the surface of the Atlantic Ocean, off Sierra Leone; surface temperature, 77°·7.

I have said that the oral apparatus has not been well examined, but enough has been

done to show that a long, strong tooth, somewhat similar in character to the rostrum, projects from the anterior surface of the epistoma, and that the mandibles exist as sharp-pointed organs, but the presence of a synaphipod could not be determined. Only one pair of gnathopoda could be seen, which I took to be the second; it consists of a long cylindrical basal joint supporting two branches, the permanent ramus being four-jointed; each joint is furnished at its distal angle with a long ciliated hair, and the terminal joint has four; the outer or deciduous branch consists of one long and one minute joint, the former furnished with a long ciliated hair on the inner and one on the outer distal angle, and the latter with four at the extremity.

One feature of interest in the development of the species from which this specimen comes, is that all or at least five out of the seven somites that belong to the pereion are developed as perfect somites posterior to the carapace. This I also found to be the case in Claus's figure of the Protozoea of *Penæus*, and in his figure of *Ericthina*, but it is not the case in Dana's figure of the typical specimens of *Ericthina*, which is believed by Professor Brooks to be the Zoea form of the genus *Leucifer*.

The next form to be considered, and which Dr. v. Willemoes Suhm says comes from the latest Elaphocaris, is that which he has described as being in the *Amphion*-stage. It is desirable in tracing the life-history under the present circumstances, when one form is said to succeed and arise from another, to take into consideration the relative sizes of the specimens, for after allowing for the variations that may occur from various conditions and circumstances, the difference of size is a great factor when we consider how gradual are the changes in the progressive history of the stages that are known. The largest Elaphocaris is about 1·7 mm., and Suhm says the *Amphion*-stage is 3·5 mm., or more than double the length.

The specimens in the Challenger collection that belong to the *Amphion*-stage of Suhm in the progressive development of *Sergestes*, are similar to those that have been described by Claus under the name of *Acanthosoma*. Of these there are several varieties, as if they were the young of more or less closely allied species, but there are two forms in which the characters are so distinct, that I think there cannot be any doubt they are stages of two different but closely allied genera. These may be arranged for convenience under the names of *Acanthosoma brevitelsonis* and *Acanthosoma longitelsonis*, leaving it to future research to determine the parent of either form. None of our specimens correspond in minute details with that figured by Claus. That given by him in his Crustaceen System (pl. v. fig. 5), of which he has represented the rhipidura only, corresponds with that of *Acanthosoma longitelsonis* (Pl. LXIV. fig. 3), whereas his figure 6, on the same plate, corresponds with that of *Acanthosoma brevitelsonis*. Professor W. K. Brooks[1] says:—"The telson is slightly notched in *Lucifer;* deeply forked in *Acetes*, and in *Sergestes* the prongs of the fork diverge so much as to form a right angle."

[1] *Phil. Trans.*, pt. i. p. 102, 1882.

The accompanying figure is that given by Suhm as the third stage of the development of *Sergestes*.

"*Sergestes* larva, in the *Amphion*-stage. Eight pairs of divided legs, pleopoda and otoliths are formed; n. s. 3·5 mm.; drawing taken from fresh specimens and by the aid of H[1] $\frac{1}{7}$.

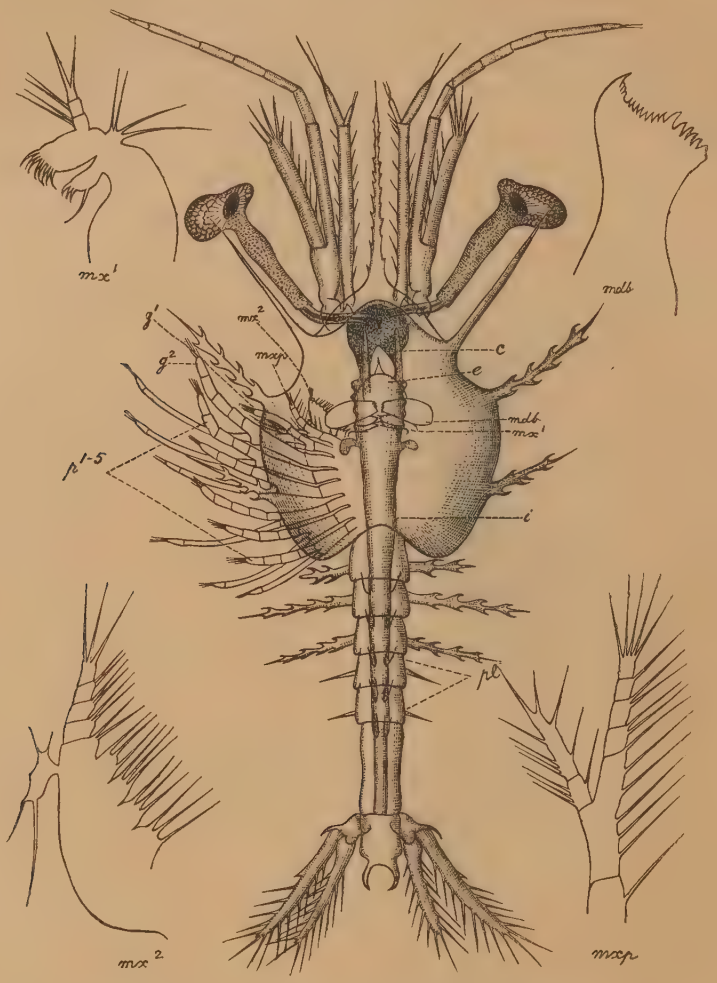

FIG. 51.—*Acanthosoma*. *e*, Cheiloglossa; *pl*, pleopoda; other lettering as before.

"Taken April 3, 1875, consequently to the south of Japan, among the Islands of Bonin, 64 × n. s.[2]

"In the adult animal the mandibles have a palpus; on the other hand, the palpus of

[1] This abbreviation refers to the microscope used in the investigation; in this case a Hartnack with ocular 1, objective 7.

[2] Fig. 51 reduced for convenience one-third.

the first maxilla becomes very rudimentary, and on the second maxilla the flabellum (mastigobranchia) enlarges, the leg-like condition disappears, and large tubercles (Warzen) are developed. The first maxillipedes like the rest of the feet (pereiopoda) lose the flagellum (basecphysis)."

The above are the notes in reference to the specimen taken by Dr. v. Willemoes Suhm, and by the aid of his clearly drawn figure, may be compared with *Acanthosoma brevitelsonis* on Pl. LXIV. fig. 1. His drawing represents the ventral and mine the dorsal aspect.

In his figure the carapace is scarcely half the length of the animal and is but slightly compressed at the fronto-lateral margin, and the frontal spines are represented as being long, smooth, and situated posteriorly to the second pair of antennæ; whereas in my specimen, which was probably captured about the same time and place, the spines are slightly serrate and are undoubtedly situated at the outer angle of the frontal margin, just above the second pair of antennæ. In Suhm's drawing the rostrum is about two-thirds the length of the carapace and serrate at the margins, whereas in mine the proportional length of the rostrum is not so great and the surface is fringed with slender hair-like processes, which perhaps under certain conditions may resemble a serrate margin, The carapace in Suhm's specimen is armed at the margins with two lateral spinous processes, but as the view given is that of the ventral surface, the dorsal spine at the posterior margin, if it exists, cannot be seen.

The five anterior somites of the pleon are laterally armed with spines; in my specimen all the spines are spinous, in Suhm's those on the fourth and fifth somites are short and smooth. The telsons in all important points are similar.

All the appendages are at the same stage in each; the pleopoda, except the sixth pair, are in a state of gemmation.

Acanthosoma brevitelsonis (Pl. LXIV. fig. 1).

The carapace is about half the length of the animal and but slightly compressed laterally. The rostrum is long, straight, about half the length of the carapace, and fringed with numerous short points or teeth. The frontal or cephalic region is advanced beyond the rest of the carapace, from which it is separated by a constriction immediately behind the second pair of antennæ and anterior to the oral appendages. On each side, at the outer angle, just above the second pair of antennæ, a long spinous process, fringed with numerous tooth-like points, projects. On each side of the outer lateral margin of the carapace, just in a line with, or slightly anterior to, the mandibles, stands a second long, flat, tapering spine-like process, fringed with numerous teeth that are larger at the base than at the apex; posterior to this, on each side, and still on the lateral margin or very close to it, stands a smaller spine-like process, furnished with fewer teeth or points;

on the posterior margin in the median line there is a solitary, erect, spine-like process, fringed with teeth on the dorsal surface, and on each side, at the lateral margin, slightly anterior to the mandibles, between them and the anterior spinous process, there arises a short but prominent spine fringed with teeth.

The pleon has the five anterior somites subequal, smooth on the dorsal surface, but armed at the postero-lateral margin of each with a long spine-like process, fringed with sharp teeth.

The sixth somite is but little longer than the fifth; it is unarmed at the postero-lateral angles, but carries a small tooth on the posterior margin of the dorsal surface.

The telson is short and bifurcate, the caudal fork being short and broad.

The ophthalmopoda are about two-thirds the length of the rostrum, gradually increasing in diameter from the base to the distal extremity, where the ophthalmus is slightly broader than the stalk, more distinctly apparent on the outer than on the inner side.

The first pair of antennæ consists of one long joint, fringed with hairs, that reaches as far as the distal extremity of the rostrum, and terminates in two small single-jointed rami tipped with one or two small hairs.

The second pair of antennæ consists of a broad basal joint, an inner multiarticulate branch that corresponds to the future flagellum, and a long, narrow, foliaceous branch that corresponds to the future scaphocerite, the outer margin of which is smooth, and furnished at the outer angle of the distal extremity with a small tooth, while the inner, which is parallel with the outer, is thin and fringed with hairs.

The mandibles are sharp-pointed and do not appear to carry a synaphipod.

The other oral appendages I have not determined, except the third pair of siagnopoda or first maxillipede, which is in an immature condition, biramose, and tipped with one or two long hairs.

The first and second pairs of gnathopoda are biramose and correspond in development with the third pair of siagnopoda. The pereiopoda are all in a very similar condition.

The pleopoda are in a very immature stage of gemmation, except the sixth pair, which is long, slender, biramose, and well developed; it consists of a basal joint armed with a tooth on the outer distal angle, and supporting two long, narrow, slender branches, with subparallel margins. The outer, which is the longer, is smooth on the outer margin to about one-third of its length, where it is armed with a short strong tooth, beyond which it is fringed with short hairs to the distal extremity, while the inner margin is fringed with long hairs, which are probably ciliated. The inner branch is straight, narrow, tapering, and fringed with hairs, probably ciliated.

Length, 4 mm. (0·16 in.).

Habitat.—The Western Pacific Ocean.

Acanthosoma tynitelsonis[1] (Pl. LXIV. fig. 2).

The specimen represented in this figure corresponds in development with that shown in fig. 1 on the same plate. It is probably a slightly older moult of a different but closely allied species.

The carapace appears to be scarcely half the length of the animal. The rostrum is not quite half the length of the carapace, and is generally free from ornamentation, except for a few points near the apical extremity. The spinous processes are also nearly free from ornamentation, and the smaller dorsal teeth are quite smooth. The lateral processes in a line with the mandibles are strongly serrate, those posterior are smaller and but slightly serrate, and the dorsal one on the posterior median line is slender and almost free from teeth.

The pleon has the five anterior somites subequal, and dorsally armed with long slightly spinous teeth, of which that on the third somite is the longest; the sixth somite is twice as long as the preceding, and dorsally armed at the posterior margin with a short smooth tooth.

The telson is short, or less than a third of the length of the outer plate of the rhipidura, and terminates in a wide short fork.

The ophthalmopoda are about two-thirds the length of the rostrum, and have the eye considerably broader than the stalk.

The first pair of antennæ is longer than the rostrum, and terminates in two short uniarticulate rami.

The second pair of antennæ has the inner branch multiarticulate, and the outer, which represents the scaphocerite, nearly three-fourths the length of the inner, scarcely broader, and armed on the outer margin with a tooth that is a considerable distance from the extremity, which, as well as the inner margin, is fringed with hairs that are rather short.

The oral appendages, as well as those of the pereion, are present, but, especially the latter, in an incipient condition.

The pleopoda are all developed, and the posterior pair which belongs to the rhipidura is biramose; they are all feeble organs except the posterior pair, which is long, narrow, and, like that of the preceding species, armed with a tooth about one-third distant from the base, the margin beyond being fringed with hairs.

Length, 4 mm. (0·16 in.).

Habitat.—The Western Pacific Ocean.

This specimen is nearly of the same size as the preceding one, but it differs in development in several points. The pleopoda are not yet visible in fig. 1, whereas in this

[1] τυνός, small.

specimen they are of considerable length, and have apparently assumed the features of the permanent organs.

The ophthalmopoda are shorter, and the scaphocerite differs in form.

Acanthosoma dorsispinalis (Pl. LXV. fig. 1).

The specimen from which this figure is taken differs very little as to the stage of its development from that represented in fig. 3, Pl. LXIII., but it differs in several important points of structure.

The carapace, exclusive of the rostrum, is about one-third the length of the body of the animal. The rostrum is nearly as long as the carapace, and thickly fringed with small spines. The postero-dorsal spine is long, robust, slightly curved backwards, and smooth, except for the presence of one small spine on the anterior margin, halfway between the base and apex; the outer antennal spine is slender and spinous; that which surmounts the mandibular area is short and denticulate, and the two lateral marginal spines are strongly serrate.

The pleon is dorsally armed with long spines which, including that on the sixth somite, are furnished with smaller spines both on the anterior and posterior margins. The postero-lateral angles of the second and three following somites are also produced into compound spines, of which the anterior is the largest and the posterior the smallest, that of the sixth somite being reduced to a simple, narrow, sharp, spine-like tooth.

The telson is short and curved upwards at the posterior extremity.

The ophthalmopoda are scarcely more than half the length of the rostrum.

The first pair of antennæ is as long as the rostrum, and terminally biramose, the two branches being short and single-jointed; the basal joint, which represents the three joints of the permanent peduncle, exists now as only one, while at the base the lateral enlargement to receive the otocyst is visible, and determined by a small, broad tooth.

The second pair of antennæ has the flagella broken off, but the terminal joint of the peduncle is preserved, as well as the scaphocerite, which is long, narrow, and armed with a small tooth on the outer and smooth side at a short distance from the apical extremity, which, as well as the inner margin, is fringed with hairs.

The oral appendages I have not examined, but the gnathopoda and pereiopoda are fairly advanced, although as yet devoid of hairs.

The five anterior pairs of pleopoda are undeveloped, but each somite in the ventral median line is produced into a long, stout, anteriorly curved, sharp-pointed tooth; the sixth somite has no such ventral tooth, and has the pleopoda fully developed, the outer plate being furnished with a strong tooth near the middle of the outer margin, the rest being fringed with long slender hairs.

Length, 2·5 mm. (0·1 in.).
Habitat.—The Western Pacific Ocean.

Observations.—It is interesting to notice that this specimen, while only about two-thirds the length of those from which figs. 1 and 3, Pl. LXIV., were taken, yet has the appendages parallel with them in development.

Acanthosoma longitelsonis (Pl. LXIV. fig. 3).

The carapace is more than one-third the length of the animal including the telson; excluding the telson it is nearly one-half.

The rostrum is about as long as the carapace, and fringed from base to apex with small teeth; a long and slender serrate spine projects above the ophthalmic notch; a short, curved, serrate process stands at the antero-lateral angle of the carapace; a little way behind it on the margin there is a long, slender, smooth spine, and a little more posteriorly is another process or smooth tooth, broad at the base, short, and sharp-pointed; the postero-lateral and posterior margins are smooth.

The pleon has the five anterior somites subequal, and dorsally armed with long serrate spines, which project from the posterior margin and increase in length from the first to the fifth somite; each somite is likewise armed on each side at the postero-lateral angle with long, slender, serrate spines that increase posteriorly to the fifth somite. The sixth somite is about as long as the two preceding ones, it is dorsally smooth and unarmed, except at the postero-lateral angles, which are produced into long, slender, serrate spines, but not so long as those on the fifth somite.

The telson is long, quite as long as the sixth somite, posteriorly forked, the limbs of the fork being parallel at first and then slightly divergent, and armed on each side with one strong posteriorly-directed tooth, and distally with several small teeth.

The ophthalmopoda, about one-third the length of the rostrum or carapace, are slightly fungiform, gradually increasing from the base and suddenly enlarging at the ophthalmus.

The first pair of antennæ has the peduncle three-jointed, and reaching to about half the length of the rostrum; the first joint is longest, the second and third subequal, and the first joint is smooth excepting for two ciliated hairs on the inner and one on the outer distal angle; the second joint has two or three ciliated hairs on the inner and two on the outer margin, and the third joint has two or three ciliated hairs on the inner margin only; attached to the distal extremity are two short branches, the outer representing the long and permanent flagellum, and the inner and shorter the future small and rudimentary appendage.

The second pair of antennæ has a stout basal joint that supports a long, slender flagellum, apparently not multiarticulate, and a long and narrow scaphocerite that is

armed on the outer or smooth side near the apex with a very long and narrow tooth, slightly serrate at the margins, and on the inner side with long ciliated hairs.

The oral appendages are advanced in development.

The third pair of siagnopoda or maxillipede is biramose, and has the several joints fringed with hairs.

The first pair of gnathopoda consists of a long basal joint, which supports two branches; that which represents the permanent limb is four-jointed, while the branch is a slender, feeble appendage.

The second pair differs from the first in being longer and in having the branch or ecphysis larger.

The five pairs of pereiopoda are all similarly developed, but become slightly shorter posteriorly.

The pleopoda exist as long, narrow, bud-like sacs, except the sixth pair, which is large and well developed. Its two branches are subequal in length, fringed with long hairs, and not longer than the telson. The outer plate has the external margin smooth in its basal half, where it is armed with a long and slender tooth.

Length, 7 mm. (0·28 in.).

Habitat.—The South Pacific Ocean.

This form, as well as *Acanthosoma brevitelsonis*, should be studied in connection with the younger stages of *Mastigopus* (Pl. LXV. figs. 3, 4), and compared with *Sergestes brachyorrhos* and *Sergestes caudatus*, Kröyer, in which the short and long telson respectively is persistent in the adult.

Another specimen was taken in the Atlantic, on the 13th April 1876, which corresponds in several respects with the present form, but differs in certain details that may depend upon a slight difference in age, and in others of more or less importance.

The form of the rostrum and carapace is the same as in the preceding, but the latter bears a large smooth tooth on each side of the gastric region, and a small tubercle in the median line between them, and just within the posterior margin; also in the median line there is another long anteriorly curved tooth.

The pleon corresponds in its adornment with that of the previous specimen, except that the posterior somite is dorsally armed with a long, serrate, spine-like tooth, and each of the postero-lateral angles terminates in a short, sharp, plain tooth, instead of in a long ornate one.

The appendages correspond with those of the specimen taken in the South Pacific, except that the pleopoda are a little more developed, and the outer plates of the rhipidura are slightly spatuliform, and have the tooth that arms the outer margin somewhat nearer to the distal extremity than to the base, and standing at the broadest diameter of the plate, which is furnished distally and on the inner side with very long ciliated hairs.

Length, 5 mm. (0·2 in.).

Habitat.—Station 352, April 13, 1876; lat. 10° 55′ N., long. 17° 46′ E.; surface temperature, 77°·7. The Atlantic Ocean; surface.

Acanthosoma macrotelsonis (Pl. LXVI. fig. 1).

Resembles *Acanthosoma longitelsonis.*

Carapace, without the rostrum, one-third the length of the animal including the telson. Rostrum as long as the carapace, smooth, except for a few points near the extremity. On each side, behind the orbital notch, stands a long, slender, spinous tooth or process, another, which is wide at the base, stands at the antero-lateral angle, and is fringed with long spines and short teeth; some distance within the margin on the dorsal surface, in a line with or slightly anterior to the mandibles, stands a third but smaller spinous process; posteriorly and nearer the margin, but at some distance within it, is a fourth small, spinous tooth, while a fifth about the same size projects from a little within the postero-lateral angle.

The pleon has the five anterior somites subequal in length, and dorsally armed with large, sharp, spinous processes projecting from the median line anterior to the posterior margin; that on the first somite is erect and curved forwards, with the anterior margin smooth and the posterior serrate; the second is like the first; the third is straight and armed with one tooth on the anterior margin, and with several on the posterior; the fourth is straight, pointing obliquely upwards and backwards, and armed with teeth on the anterior and posterior margins; the fifth resembles the fourth in form but is smaller. Each somite is likewise armed at the postero-lateral angle with a long, slender, spinous process, of which those on the third and fourth somites are somewhat the longest.

The sixth somite is as long as the three preceding; it is dorsally smooth and unarmed, and furnished with a small smooth tooth near the postero-lateral angle.

The telson is as long as the sixth somite; it is deeply forked and armed on the lateral margin with three fine, distantly placed teeth.

The ophthalmopoda are fungiform and about half the length of the rostrum; from a slender stalk at the base it increases at first suddenly and then gradually to the ophthalmus, which is nearly twice the diameter of the stalk.

The first pair of antennæ consists of two joints; the first is long and narrow except at the base, which is considerably enlarged, forming a broad tooth on the outer side for the purpose of enclosing the otocyst. The margins beyond are straight, parallel, and fringed on the inner side with a row of distantly placed hairs. The second joint is short, attached to the first obliquely, obtusely pointed, and tipped with a few hairs. The first joint probably represents the whole of the future peduncle, and the second the future flagellum.

The second pair of antennæ consists of a basal joint supporting a long and slender

flagellum that appears not to be multiarticulate, and a long and narrow scaphocerite that is not armed with a tooth on the outer side, but is tipped with long hairs at the extremity, and has others that gradually decrease in size from the extremity and disappear about halfway down.

The gnathopoda and pereiopoda are advanced in development and biramose, but still in a saccular condition.

The pleopoda are also considerably advanced, but saccular in form, except the sixth pair, which is long and narrow, with the margins parallel and the branches equal. There is no tooth on the outer margin of the external plate, but its place is taken by a small hair or spine, one-fifth distant from the basal articulation, from which point the outer margin is fringed with short hairs, that increase in length to the apex; the inner side of this as well as both sides of the inner plate are also similarly adorned.

Length, 3 mm. (0·12 in.).

Habitat.—Samboangan, Philippines.

Acanthosoma lævirostratis (Pl. LXV. fig. 2).

Carapace about one-third the length of the body of the animal (a little longer than shown in the figure). Rostrum scarcely as long as the carapace, smooth and unarmed. The outer orbital angle carries a long serrate process (which is not clearly shown in the plate as being distinct from the first antenna), a second stands on the antero-lateral angle, another smaller one exists between it and the mandibular attachment, or over it, and a fourth projects from the lateral margin, near the branchial region.

The pleon has each somite dorsally armed with large spinous processes, that stand anterior to the posterior margin, and are all strongly but varyingly spinous; the largest is on the fourth somite, and the smallest on the sixth. The second, third, fourth, and fifth somites are also armed at the infero-lateral margins with strongly serrate spines, but the first somite is smooth and free from ornamentation, and the sixth is furnished with a small smooth denticle. The ventral surface has in the median line a longitudinally narrow, rounded protuberance on the five anterior somites.

The telson is long, slender, forked, and distally armed with a few tooth-like processes.

The ophthalmopoda are shorter than the rostrum and fungiform, the ophthalmus being more than twice the breadth of the stalk.

The first pair of antennæ is longer than the rostrum, and consists of two joints, the basal being long, slender, and reaching considerably beyond the extremity of the rostrum, the second obliquely attached to the extremity of the first, and about one-third of its length, and at its base is the rudiment of the second ramus.

The second pair of antennæ has a basal joint, and supports a slender flagellum that does not reach beyond the extremity of the first pair, and a narrow scaphocerite with

parallel margins, the outer margin being produced to a long blunt tooth at a distance from the extremity, and the inner fringed with long hairs that are rather distantly separated.

The gnathopoda and pereiopoda are biramose and tolerably advanced in development.

The pleopoda are developed on the third, fourth, and fifth somites as unequally biramose, saccular appendages, but I could not detect any on the first two somites; those of the sixth are large and well formed, and have the tooth on the outer margin of the outer plate situated about halfway between the apex and the base.

Mastigopus dorsispinalis (Pl. LXV. fig. 3).

The next stage in which I am able, with the specimens at my command, to trace the progressive development of the short telson form, is in that which Claus has named *Mastigopus*. In the Challenger specimens in this stage also, as previously in *Acanthosoma* and *Elaphocaris*, there appear to be more than one species represented.

The carapace, not including the rostrum, is rather less than a third of the length of the body of the animal. The rostrum is about half the length of the carapace, and unarmed; a small but strong tooth stands at the outer angle of the orbit, and another on each side slightly posterior to the gastric region.

The pleon has the posterior margin of the dorsal surface of each somite armed with a strong tooth, but the postero-lateral angles are smooth and rounded off, except the fifth and sixth, which are produced to a small tooth. The sixth somite is quite as long as the two preceding.

The telson is about half the length of the sixth somite.

The ophthalmopoda are subequal in length to the rostrum. The ophthalmus is broader than the stalk, which narrows gradually to the base.

The first pair of antennæ has the peduncle three-jointed. The first joint is long and slender, broad at the base for the reception of the otocyst, and armed on the outer side with a sharp, stout tooth, whence it suddenly narrows and continues cylindrical to the distal extremity, where it supports the second joint, which is about half the length of the first and a little longer than the third, and this, in turn, supports a flagellum about as long as the peduncle, and a small, secondary, single-jointed branch.

The second pair of antennæ has the flagellum broken off at the peduncle; it carries a long, narrow scaphocerite, subapically furnished with a sharp tooth on the outer side, and fringed with hairs on the inner.

The first pair of gnathopoda has so far assumed the adult character in having the carpos curved at the meral extremity.

The second pair has also much of the character of those of the adult animal; the first three or four joints being robust, and the two terminal ones slender and feeble.

The first pair of pereiopoda is short, not half the length of the preceding pair of appendages, appears to be only four-jointed, and exhibits no sign of having any prehensile power at the ultimate articulation. The second pair is longer than the first and not chelate, but terminates in a feeble joint, tipped with one or two hairs. The third pair is longer than the second, and, like it, not chelate, but terminates in an immature dactylos. The fourth and fifth pairs are in an incipient stage of gemmation.

The pleopoda are in a tolerably advanced stage; the first pair is single-branched, the others biramose. The sixth pair, which helps to form the rhipidura, is well developed; the outer plate is armed near the middle of the outer margin with a sharp tooth, and beyond this it is furnished with long and slender hairs.

Length, 6 mm. (0·24 in.).

Habitat.—Taken on March 15, 1875; lat. 1° N., long. 146° E.; in the Pacific Ocean, north-west of the Admiralty Islands.

This form has the branchiæ undergoing development. A two-lobed plume is attached to the membranous articulation between the walls of the pereion and the coxa of the second pair of gnathopoda (*i*).

The first (*k*) and second (*l*) pairs of pereiopoda have each a seven-lobed plume similarly situated, while those attached to the third and fourth pairs are smaller, and appear to be fixed to the pereion rather than to the membranous articulation of the leg.

The stomach is visible through the carapace, and contains small masses of undigested food.

On each side of the carapace, posterior to the gastric region, there is a strong tooth, which owing to compression from the mounting of the specimen is represented too high in the figure; from it a fasciculus of muscles appears to spring, and are attached to the apophysis of the mandible.

Observations.—The slide on which this specimen is preserved is labelled by v. Willemoes Suhm "Sergestes cr. larva ten., W. Pacific," by which I presume that he considered one specimen to be *Sergestes crassus*, and others to be the young of some species that he proposed to name *Sergestes tenuis*.

Mastigopus acetiformis.

Carapace one-third the length of the animal. Rostrum about two-thirds the length of the carapace, smooth, slender and horizontal; a small tooth situated behind the orbital angle on the dorsal surface; none corresponding with the position of the antennæ but a small cusp on the fronto-lateral angle; a small tooth stands above the mandibular attachment. The anterior five somites of the pleon are subequal in length, and all are

dorsally smooth except the posterior, which is furnished at the posterior margin with a small tooth. The infero-lateral margin of these somites is produced to a sharp tooth, which gradually increases in length posteriorly, the anterior three being directed forwards and the others obliquely backwards; in the median ventral line is a deep, longitudinally compressed, rounded cusp. The sixth somite is about equal in length to the two preceding, and posteriorly terminates on the dorsal surface in a small tooth.

The telson is about as long as the sixth somite, and terminally forked with two small teeth.

The ophthalmopoda are fungiform and subequal in length to the first joint of the peduncle of the first pair of antennæ.

The first pair of antennæ has the peduncle three-jointed and about as long as the carapace; the first joint is longer than the second, and is enlarged at the base, which is furnished with a sharp anteriorly directed tooth and encloses the otocyst, and the second a little shorter than the third, which supports a multiarticulate flagellum that is as long as the peduncle, and a small uniarticulate secondary ramus.

The second pair of antennæ is broken off at the extremity of the peduncle; it supports a scaphocerite with parallel margins, and nearly as long as the peduncle of the first pair, and is armed with a long and slender tooth near the distal extremity. The basal joint of the peduncle is also armed with a strong tooth at the outer distal angle.

The first pair of gnathopoda is formed after the type of the adult organ, as is also the second pair.

The pereiopoda that are developed have lost their lateral ecphyses, and have not attained the form of the minute chelæ, at the extremity of the second and third pairs, which are present in the mature form, while the fourth still exists as a small saccular appendage, and the fifth is very minute and rudimentary.

The pleopoda have attained much of their adult character, but their inner branch has not yet reached its normal proportions.

The posterior pair is long, slender, and slightly curved, and is armed with a strong tooth near the middle of the outer margin of the outer branch, while the inner is narrow, pointed, one-fourth shorter, and fringed with hairs.

Length, 6 mm.

Habitat.—The Western Pacific Ocean. (Labelled "Y." (? young) "*Sergestes* V." in Suhm's series.)

This specimen corresponds in general characters with that given on Pl. LXXVI. fig. 2, and it differs only in those temporary features which disappear with age.

It has the rostrum shorter and free from serrature along the margins. It is smooth and does not reach as far as the extremity of the peduncle of the first pair of antennæ. The tooth or spine that stands above the first pair of antennæ is reduced in

proportions, and is not serrate on the surface. That on the fronto-lateral angle of the carapace is reduced to a mere point, while that above the hepatic region is short and slender, and one of the marginal spines has disappeared. The pleon has no dorsal teeth anterior to the fifth and sixth somites, on each of which there exists a small tooth at the posterior extremity. The teeth on the lateral margins exist as sharp points that are smooth and free from ornamentation.

Observations.—This specimen appears to show the gradual transition of the form *Acanthosoma* into that of *Mastigopus*, by the loss of the ecphyses and the gradual formation of the pereiopoda, *pari passu* with the reduction of the spinous character of the animal.

Mastigopus suhmi, n. sp. (Pl. LXVI. fig. 2).

Carapace, excluding the rostrum, one-third of the length of the body of the animal. Rostrum less than half the length of the carapace, subapically armed with two or three small teeth; a small tooth stands on the outer angle of the orbit and another at the antero-lateral angle of the carapace; the lateral and posterior margins are smooth and free from ornamentation.

Pleon dorsally and laterally free from teeth or spines, except a small tooth on the posterior dorsal margin of the fifth and sixth somites.

Telson less than half the length of the sixth somite, broad at the base and suddenly narrowing towards the extremity, where it is minutely forked.

The ophthalmopoda are pyriform, narrow at the base and broad at the ophthalmus, but the widening is not very sudden.

The first pair of antennæ has the peduncle longer than the rostrum, and is three-jointed; the first joint is broad at the base, being expanded to contain the otocyst, and the outer angle is armed with a tooth, from which the joint suddenly narrows and reaches to about two-thirds of the length of the rostrum. The second joint is narrow, with parallel margins, and reaches to the extremity of the rostrum; the third joint is shorter than the second and supports a long and a short flagellum (the longer flagellum is broken off).

The second pair of antennæ has a broad coxal joint, which supports a flagellum that is broken off and a scaphocerite that is as long as the rostrum, armed with a tooth on the smooth side near the distal extremity, and furnished on the opposite and distal margins with long and slender hairs.

The oral appendages have not been closely examined.

The first pair of gnathopoda has assumed its appearance in the adult, the ante-penultimate joint having a knee-like bend near the meral articulation.

The second pair of gnathopoda has the coxal joint short and broad, the second long

and robust, and fringed with hairs on the anterior margin, the third short and slender, and fringed with hairs on the anterior margin, as are the two following joints, which are subequal in length and terminally pointed.

The first pair of pereiopoda is missing. The second and third pairs are long and slender. The basal joints are short and robust, the second long and stouter than the first, but not so long nor so stout as that of the second gnathopod; the three following joints are subequal in length to and a little slighter than the previous joints, and are fringed on each side with long and slender hairs. The fourth and fifth pairs of pereiopoda exist as rudimentary buds.

The pleopoda are so far developed as to resemble their permanent form.

The first pair is long, slender, and single-branched, the terminal joint being fringed with hairs. The second is shorter and biramose, as are also the three succeeding pairs, each being a little shorter than the preceding, and all are fringed with hairs. The sixth pair is long and well developed, more than twice as long as the telson and nearly as long as the sixth somite; the outer branch is slightly longer than the inner and is armed on the outer margin with a tooth, about midway between the base and the apex, and beyond this fringed with long hairs, as well as on the inner margin, as are also the margins of the inner branch.

Length, 5 mm. (0·2 in.).

Habitat.—The North Atlantic Ocean.

Mastigopus spiniventralis, n. sp. (Pl. LXVII. fig. 4).

Carapace about one-third the length of the body of the animal, anteriorly produced to a long, sharp, straight rostrum, that is more than one-third the length of the carapace, nearly as long as the ophthalmopod, and armed on the dorsal surface at the base with a small tooth; a still smaller one exists on the median dorsal line of the posterior margin.

The pleon has the first five somites subequal in length. The first has the dorsal surface smooth, the second is armed with a small tooth on the posterior margin, the third, fourth, and fifth are similarly armed, but with larger teeth at right angles to the surface. The sixth somite is longer than the two preceding somites together, and is armed at the posterior margin of the dorsal surface with a small tooth directed horizontally backwards; it is also produced to a point at the postero-lateral angle, whereas those of the five preceding somites are smoothly rounded off. From the ventral median line of each somite except the sixth there projects a long tooth, broad at the base and sharply pointed. The anterior teeth are curved forwards, but the direction is gradually changed so that the posterior tooth is directed obliquely backwards.

The telson is stout, terminating in a short fork (4z).

The ophthalmopod is about half the length of the carapace, or a little longer than the rostrum, narrow at the base, and gradually widening until it reaches the ophthalmus, which is slightly broader than the stalk at its distal extremity.

The first pair of antennæ has the first joint of the peduncle as long as the ophthalmopod, broad at the base, where it is expanded to contain the otocyst, and armed with a small tooth or point, from whence it is narrow and cylindrical to the extremity; the second joint is about one-third the length of the first and slightly longer than the third, which supports a long and slender flagellum that makes the antennæ equal to two-thirds the length of the animal.

The second pair is longer than the first, being about equal to the length of the animal, and carries a scaphocerite that is as long as the peduncle of the first pair, armed near the distal extremity with a strong tooth, and having the inner margin fringed with long hairs.

The first and second pairs of gnathopoda are so far developed as to assume the character in the adult.

The first pair of pereiopoda also resembles that of the adult animal, but has not yet prehensile power developed, and at the base, on the anterior margin, stands a small tubercle that is probably of specific value; a similar process is placed in the same position on the second pair of pereiopoda, but is absent from the third. The second and third pairs differ from those in the adult in not terminating in a small chela; the small terminal dactylos is not yet developed, and in its place there are two long terminal hairs. The fourth and fifth pairs are not yet visible, even as buds.

The pleopoda are long, slender, and well advanced in development; the first pair is single-branched and the following pairs are biramose. The terminal pair is long and narrow, fringed with hairs on both sides, but not armed with a tooth on the external margin of the outer plate.

Length, 7 mm. (0·3 in.).

Habitat.—The Western Pacific Ocean.

A very closely allied specimen (Pl. LXVII. fig. 5) was taken in the North Pacific, but it differs in having the rostrum shorter, it being scarcely more than one-third the length of the ophthalmopod (5*a*), and in having a small tooth on the outer margin of the outer plate of the rhipidura (5*v*); the second and third pairs of pereiopoda exhibit an incipient chela (5*l*). It is probably a later moult, as the animal has arrived at the *Sergestes* stage.

A third specimen was taken, also in the Western Pacific (Pl. LXVII. fig. 6), which differs from the two preceding in not having the rostrum armed with a small tooth on the dorsal surface, but a small elevation or protuberance occupies its place. There is also another variation. In the specimen we have described (fig. 4) there is a small tooth projecting from the outer angle of the orbit. This tooth is still more prominent in the

specimen given in fig. 5, but is entirely wanting in that from which fig. 6 is taken, and the fourth (*n*) and fifth (*o*) pairs of pereiopoda are here in a stage of gemmation, whereas in fig. 4 they are not appreciable.

Length, 4 mm. (0·17 in.).

Habitat.—The Pacific Ocean; taken March 15, 1875, about 5° north of New Guinea.

Mastigopus crassus, n. sp. (Suhm, MS.).

"*Sergestes* (*'crassus'*).

"Larval stage previous to the moulting of the mature animal.

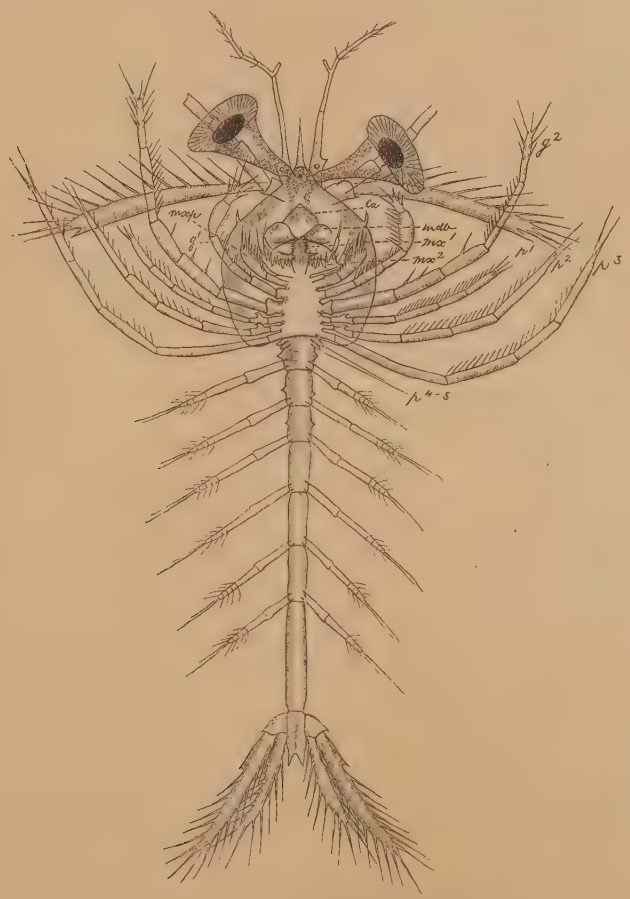

FIG. 52.—(IV) *Mastigopus crassus*. *la*, labrum; *mdb*, mandible; *mx*¹, first maxilla; *mx*², second maxilla; *mxp*, maxilliped; *g*¹, first gnathopod; *g*², second gnathopod; *p*¹, first pereiopod; *p*², second pereiopod; *p*³, third pereiopod; *p*⁴⁻⁵, fourth and fifth pereiopoda.

"The posterior two pereiopoda are only rudimentary, and the animal now morphologically resembles a *Leucifer*.

" Otoliths present.

" H. $\frac{1}{7}$; about 35 times nat. size.

" Taken on the voyage from Hilo to Tahiti, lat. 5° 0′ N.

" Length of rostrum,	0·31 mm.
„ „ carapace, without rostrum,	1·0 „
„ „ abdomen,	2·5 „
Entire length,	3·8 „
Length of ophthalmopod,	0·63 „
Width „ „	0·49 „
Length of scale,	1·08 „
„ „ telson,	0·35 „
Width of carapace,	0·84 „

" Branchiæ still wanting.

" Of the lateral spines of the carapace one is still to be seen."

The preceding figure (fig. 52) is reduced one-third from Dr. v. Willemoes Suhm's drawing, and represents what he calls the fourth or *Leucifer*-stage, or that immediately preceding the adult form. It corresponds closely with that which I have just described as *Mastigopus suhmi*, and which is represented on Pl. LXVI. fig. 2. It differs, however, in some details of more or less importance; Suhm's specimen, for instance, is 3·8 mm. long, while mine is 5 mm., and the carapace is rounder in Suhm's than in that which I have drawn. He represents the ophthalmopoda as being more fungiform and the scaphocerite as being very much longer.

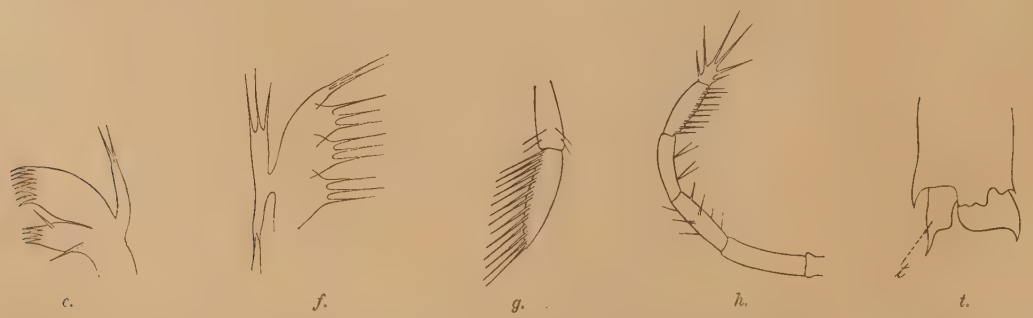

FIG. 53. Oral appendages of *Mastigopus crassus*. *e*, First maxilla; *f*, second maxilla; *g*, maxillipede; *h*, first gnathopod; *t*, telson, seen laterally.

The form of the oral appendages is shown in the annexed cuts (fig. 53).

The second pair of gnathopoda is well shown in fig. 52, as also are the several pairs of pereiopoda; the first and second having the basis furnished with a small tubercular process on the anterior margin, similar to that shown in *Mastigopus spiniventralis* (Pl. LXVII. fig. 4). The second and third pairs have not as yet assumed the chelate

condition of the adult form, while the fifth and sixth pairs are in an early stage of gemmation.

The pleopoda are represented by Suhm as being single-branched, whereas in my specimen they are all, excepting the first pair, more or less perfectly biramose.

The sixth pair differs only in being more slender, with the margins parallel, and in having the tooth on the outer margin nearer the basal articulation. The appendage is long and narrow when compared with that which I have given. The telson is short, as is relatively shown in the figure (at *t*). Suhm remarks that it much resembles the typical features of a young *Leucifer*.

Observations.—By tracing the several stages, we may safely conclude from the direct structural affinities, that *Mastigopus* is a young *Sergestes*, and that it is preceded by the Acanthosoma stage. But the interval between Acanthosoma and Elaphocaris is so great that a comparison of all the various forms which we believe to belong to distinct species requires us to insist upon a clearer demonstration of the developmental connection between the two. If we could bridge over this chasm we might safely trace the sequence, if not in a single direct line, certainly through closely allied genera, to the Elaphocaris, shown by v. Willemoes Suhm to have left the ovum so recently that the yolk-mass had not been all absorbed when he observed it.

Sergestes intermedius, n. sp.

Rostrum one-third the length of the carapace, armed with a tooth on the dorsal crest, just above the orbital margin, and with a small denticle just within the posterior margin in the dorso-median line; the rest of the carapace is smooth, excepting a small tooth on the hepatic region above the point of the mandibular attachment.

Pleon having the five anterior somites subequal in length; the sixth about twice that of the fifth somite. The anterior three are dorsally smooth, the posterior three are armed with a small tooth at the posterior dorsal margin, the last of which is horizontally produced; all the somites are furnished with a small tooth projecting from the lateral walls, and the ventral surface is armed in the median line with a large longitudinally compressed spine-like tooth between each of the anterior five pairs of pleopoda.

The telson is about half the length of the sixth somite and terminates in two small points.

The ophthalmopoda are nearly twice as long as the rostrum, and the ophthalmus is obliquely mounted on, and broader than the stalk, and fungiform in appearance.

The peduncle of the first pair of antennæ is enlarged at the base for the reception of the otocyst, reaches beyond the ophthalmus, and terminates in two flagella, of which the longer is broken off, and the smaller is uniarticulate and rudimentary.

The second pair of antennæ is broken off at the extremity of the peduncle; a long and

narrow scaphocerite springs from the second joint and reaches as far as the distal extremity of the ophthalmopod, where, on the outer side, it is subapically armed with a small tooth.

The first pair of gnathopoda is robust, the terminal joint is ovate and much smaller than the penultimate, which is long, broad, flat and ovate, and the antepenultimate joint is genuflexed near the adjoining articulation.

The second pair of gnathopoda is very long; the basis is short and suddenly enlarged to a considerable diameter; the ischium is much narrower than the basis, but the two next succeeding joints are long, moderately broad, have the margins subparallel and reach as far as the extremity of the ophthalmopod; the next three succeeding joints narrow to about half the diameter of the preceding, and taper slightly to a blunt apex that has the margins sparsely furnished with a few hairs.

The first pair of pereiopoda is short, five-jointed, and sparsely fringed with long hairs. The two succeeding pairs are long, slender, and furnished with minute chelæ. The penultimate pair is short, saccular and rudimentary, and the last pair is only in a state of gemmation.

All the pleopoda anterior to the rhipidura have only one branch developed; at the base of each branch is a small bud-like process that becomes larger on each successive pair.

Length, 5 mm. (0·2 in.).

Habitat.—China Sea, off Luzon. One specimen.

Observations.—Considerable interest is attached to this little species, which I have named in accordance with its apparently intermediate condition, and because it appears to possess features that are in part common to several species. It resembles *Sergestes læviventralis*, *Sergestes nasidentatus*, *Sergestes longispinus*, and the immature form *Mastigopus spiniventralis* in the character of the rostrum, which corresponds in relative proportion more nearly with that of *Sergestes longispinus* than with that of any of the others named.

It differs from all the preceding species in having a series of large, broad, and longitudinally compressed spine-like processes projecting in the median line, one on each of the ventral surfaces of the several somites; in this, however, it agrees with *Mastigopus spiniventralis*, as also in the form of the rostrum and in the presence of a small denticle at the postero-dorsal extremity of the carapace; it also corresponds with it in having no tooth on the outer margin of the outer plate of the rhipidura, in which respect it differs from the other allied species.

It differs from *Sergestes nasidentatus* in having a tooth on the dorsal surface of the three posterior somites, and from *Sergestes longispinus*, *Sergestes læviventralis*, and *Mastigopus spiniventralis* in having no teeth on the dorsal surface of the anterior three somites of the pleon.

Sergestes intermedius has the appearance of being the early stage of an animal that

has acquired specific features, but is not yet maturely developed, since the dactyli of the second and third pairs of pereiopoda are shorter than the pollex, as if these minute chelæ were not yet fully developed; a condition that is also apparent in the incipient stage of the two posterior pairs of pereiopoda, and in the immature condition of the inner ramus of the pleopoda.

It is highly probable that this species is a more advanced form in the development of that of which *Mastigopus spiniventralis* is but a younger stage.

Sergestes prehensilis, Spence Bate (Pl. LXXI.).

Sergestes prehensilis, Sp. B., Ann. and Mag. Nat. Hist., ser. 5, vol. viii. p. 193, 1881.

Carapace about one-fourth the length of the animal, slender and smooth, armed in front with a short, sharply-pointed rostrum, directed obliquely upwards. Pleon smooth. Telson half the length of the outer ramus of the rhipidura.

Ophthalmopod (*a*) about twice the length of the rostrum, without a tooth or tubercle on the side. Ophthalmus large, in breadth equal to half the length of the ophthalmopod.

The first pair of antennæ (*b*) has the peduncle three times as long as the ophthalmopod; the first joint is flattened and centrally hollowed, without a prosartema, which is represented by a tuft of hairs, and the stylocerite is short, stout, and terminates in a sharp tooth; the two succeeding joints are nearly as long as the first, cylindrical, and terminate in two flagella, one of which is extremely long, and has a small multiarticulate enlargement at its base supporting slender, flexible cilia; the second is short, slender, and feeble, being a little longer than the terminal joint of the peduncle.

The second pair of antennæ has the scaphocerite nearly as long as the peduncle of the first pair, and has the external tooth in a line with the distal extremity. The phymacerite exists as a small tubercle, directed forwards and upwards, and the ancecerite on the upper surface is curved and pear-shaped.

The mandibles (*d*) have sharp and even psalisiform margins, and carry a long, slender, two-jointed synaphipod; behind them are two long bat-shaped metastomata, which overlie the mandibles, and the margins meet the cheiloglossa in front.

The first pair of siagnopoda (*e*) is three-branched, and resembles that of *Benthesicymus* and *Gennadas*.

The second pair (*f*) is three-branched, and carries a broad mastigobranchial plate that projects anteriorly as far forwards as the extremity of the second foliaceous branch.

The third pair (*g*) is three-branched; the first or coxa is short, and carries a long mastigobranchial plate; the second is foliaceous, and armed on the inner side with long serrate spines; the third consists of three joints articulating in succession, the basal being armed with two large and several small spines, and carrying on the outer side a long narrow, membranous plate.

The first pair of gnathopoda (*h*) is robust, long, and pediform, terminating in a short, reversely curved and obtusely pointed stout dactylos.

The second pair (*i*) is long, slender, and feeble, terminating in a long, straight, slender dactylos, bordered with long hairs.

The first pair of pereiopoda (*k*) is rather short and generally feeble; it is six-jointed, the dactylos apparently being absent. The propodos is long, slender, and bordered with long articulated hairs, and near its articulation with the carpos there is a fasciculus of serrate hairs or spines mounted on a tubercle which corresponds with another on the adjacent portion of the carpos, and together forming a feeble prehensile organ. The meros is long and the ischium short.

The two succeeding pairs (*l*, *m*) are longer than the others; the two penultimate joints represent the carpos and propodos, and are slender, long, and terminate in a microscopically minute but perfect chela.

The fourth pair (*n*) is one-fourth shorter than the preceding; the terminal joints are broken off in our specimen.

The fifth pair (*o*) is short, six-jointed, and feeble, it is half the length of the second and third, and furnished with a few long hairs.

The branchiæ consist of a podobranchial plume attached to the small or rudimentary mastigobranchial plate belonging to the first pair of gnathopoda; a pleurobranchial plume, with an interstitial foliaceous plate, attached to the three next somites, and two well-developed plumes attached to the two succeeding somites. The branchial formula is represented in the annexed table.

Pleurobranchiæ,	...	1'	1'	1'	2	2	...
Arthrobranchiæ,	...	...	...	...	...	...	...
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	1	...	...	...	...	...	...
	h	i	k	l	m	n	o

The first pair of pleopoda is long, single-branched, and in the adult male carries a large petasma which is hooked in the median line to its fellow of the opposite side.

The second pair carries a small, pointed, scale-like appendage attached to the base of the inner branch, and tipped with a few short spines. The anterior two pairs are long and slender, the succeeding three are robust and short. The posterior pair forms the outer plates of the rhipidura, the telson being only half their length.

Length (male), 38 mm. (1·5 in.).

Habitat.—Station 236, June 5, 1875; lat. 34° 58′ N., long. 139° 29′ E.; off Japan; depth, 775 fathoms; bottom, green mud; bottom temperature, 37°·6. One specimen, male. Trawled.

This species resembles *Sergestes cornutus*, Kröyer, from which, however, it differs in not having a small tooth on the dorsal surface of the rostrum, although there is an eminence

corresponding with its position. The ophthalmus is more orbicular, and it is larger in diameter than the stalk, whereas in *Sergestes cornutus* the ophthalmopod is pear-shaped, gradually lessening from the broadest diameter to the base. The first pair of antennæ, as shown in Kröyer's figure, has the flagellum more than twice the length of the animal, whereas in this specimen it is less than half the length; but it is not improbable that so slender an organ may have been broken off, without any very obvious trace of the accident being apparent.

The rhipidura in *Sergestes cornutus* has the outer margin of the external plate armed with a distinct tooth, whereas in the Challenger specimen it is feeble and not clearly defined.

Sergestes japonicus, Spence Bate (Pl. LXX. figs. 1, 2).

Sergestes japonicus, Sp. B., *loc. cit.*, p. 194.

Anterior surface of the carapace projecting into a short dorsal rostriform crest; the rest of the carapace smooth. Pleon smooth, laterally compressed. The ophthalmopod long and subcylindrical, the ophthalmus being scarcely broader than the stalk.

The first pair of antennæ has the peduncle half as long as the carapace, and terminates in one long and one minute flagellum, the latter being scarcely half as long as the terminal joint of the peduncle. Synaphipod of the mandible two-jointed, long and slender, reaching as far forward as the extremity of the peduncle of the second pair of antennæ.

The pereiopoda, except the last two, are broken off.

The pleopoda are generic in character, and offer nothing for specific distinction. The rhipidura is long and narrow; the telson is about two-thirds the length of the outer ramus.

Habitat.—Station 232, May 12, 1875; lat 35° 11′ N., long. 139° 28′ E.; off the southern coast of Japan; depth, 345 fathoms; bottom, green mud; bottom temperature, 41°·1. One specimen. Both trawl and dredge were used.

Length (female), 50 mm. (2 in.).

Station 207, January 16, 1875; lat. 12° 21′ N., long. 122° 15′ E.; off Manila; depth, 700 fathoms; bottom, blue mud; bottom temperature, 51°·6. Two specimens (females). Trawled.

Length, 27 mm. (1·1 in.).

The texture of this species is soft and membranous, the tissues being exceedingly transparent and reticulate. The dorsal median line is elevated anteriorly into a small laterally compressed crest, which projects forwards to a point.

The ophthalmopod is nearly as long as the first joint of the peduncle of the first pair of antennæ, and supports an ophthalmus that is black in colour, and not broader than

the stalk, which is not furnished with an ophthalmic tubercle. The first pair of antennæ (fig. 1*b*) has the peduncle about half the dorsal length of the carapace; the first joint is broad, flat, and notched on the outer margin. The second and third are cylindrical, the latter terminating in a long, multiarticulate flagellum, and a short rudimentary one.

The second pair of antennæ (fig. 1*c*) carries a very transparent scaphocerite, reticulated in appearance and not strengthened by a ridge on the outer margin.

The specimen is much dilapidated, the gnathopoda being the only appendages of the pereion that are perfect, and they present nothing of specific value.

The branchiæ consist of seven plumes, which are well developed, and correspond rather with the second pair of gnathopoda and the first two pairs of pereiopoda than with the more posterior appendages. With the exception of the plume which is attached to the small mastigobranchial plate of the first pair of gnathopoda, and which is therefore a podobranchial one, none of the plumes have any connection either with the legs or with their membranous articulations. They are, therefore, pleurobranchial.

Between the somite that supports the first pair of gnathopoda and that which carries the second is a small discoidal plate attached by one extremity; a similar organ exists in the furrow between each pair of somites, as far as the antepenultimate or the one pertaining to the third pair of pereiopoda; two branchial plumes, of a somewhat impoverished character, are attached to the next or penultimate somite. The branchial arrangement is tabulated in the following formula:—

Pleurobranchiæ,	...	'1	'1	'1	'1	2	...
Arthrobranchiæ,	...	...	...	...	...	...	...
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	1	...	...	...	...	...	...
	h	i	k	l	m	n	o

The interstitial foliaceous plate being represented by a comma.

The plumes consist of a central stem supporting lateral branches, on each side of which is a series of small, laterally compressed plates that look like scrolls upon the outer surface of the plume; these diminish posteriorly where the branchiæ are less characteristically developed.

The type specimen was taken off the southern coast of Japan in about 345 fathoms of water, but near a point where it suddenly dips to a thousand.

Sergestes kröyeri, Spence Bate (Pl. LXX. figs. 3, 4).

Sergestes Kröyeri, Sp. B., *loc. cit.*, p. 193.

Rostrum elevated into a short, crest-like tooth. Carapace smooth, having the visceral regions well defined. Pleon laterally compressed. Telson two-thirds the length of the outer ramus of the rhipidura.

Ophthalmopod (fig. 3*a*) half the length of the first joint of the first pair of antennæ, which is slightly excavated on the upper surface, and is free from any hirsute fringe. Stylocerite reduced to a pointed bulb at the base. Second joint half the length of the first and a little longer than the third (flagella broken off).

Second pair of antennæ furnished with a scaphocerite that reaches to the extremity of the peduncle of the first pair (flagellum wanting).

First pair of pleopoda very long, single, slender; second and succeeding pairs biramose.

Length (female), 63 mm. (2·5 in.).

Habitat.—Station 170, July 14, 1874; lat. 29° 55′ S., long. 178° 14′ W.; off the Kermadec Islands; depth, 520 fathoms; bottom, volcanic mud; bottom temperature, 43°. One specimen, female. Trawled.

This species closely resembles *Sergestes japonicus*, but is distinguished by the short, stout ophthalmopod and the large ophthalmus, as well as by the structure of the branchiæ, which are represented in the case of each species on the same plate.

Sergestes atlanticus, Milne-Edwards (Pls. LXVIII. and LXIX).

Sergestes atlanticus, Milne-Edwards, Ann. d. Sci. Nat., tom. xix. p. 349, Mars 1830.
„ „ Milne-Edwards, Hist. Nat. Crust., vol. ii. p. 428, 1834.
Sergestes frisii, Kröyer, Monograph. Fremstilling af Kræbs. Sergestes, pp. 19, 60, Tab. i. *a–v*, 1850.
Sergestes arcticus, Kröyer, Monograph. Fremstilling af Kræbs. Sergestes, pp. 24, 60, pl. iii. fig. 7*a–g*, pl. v. fig. 16.
„ „ Sidney Smith, Rep. Decapod Crust. "Albatross" Dredgings off East Coast U.S. in 1884, p. 6, pl. xx. figs. 1, 2, 1886.

Rostrum straight, rudimentary. Ophthalmopoda pyriform, much shorter than the first joint of the first pair of antennæ. The ophthalmus is broader than long, without any great distinction from the pedicle, which it does not equal in length, except in the old animals, in which also the ophthalmus becomes very distinct from the pedicle.

The peduncle of the first pair of antennæ is only about one-seventh shorter than the carapace; the third joint is longer than the second, and equal to or a little longer than the first.

The peduncle of the second pair of antennæ has the last joint somewhat clavate and robust; it is about one-third the length of the scaphocerite.

The sixth somite of the pleon is about a sixth of the length of the animal, and about twice as long as deep, much shorter than the fourth and fifth somites combined, and also shorter than the first and second combined, but about four times longer than the telson.

The pleopoda are very large and robust, the basal joint of the fifth pair being nearly twice as long as broad.

The outer branch of the rhipidura is armed with a tooth on the outer posterior margin, at about one-third of the distance from the terminal apex (Kröyer).

Habitat.—North Atlantic, June 18 and 19, 1873; Stations 62 and 63, on the passage from Bermuda to the Azores. Three specimens; one male, two females. Trawled.

Between Tenerife and St. Thomas.

Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; off Monte Video; depth, 600 fathoms; bottom, green sand; bottom temperature, 37°·2. Trawled.

Length, 38 mm. (1·5 in.).

Station 42, April 30, 1873; lat. 35° 58′ N., long. 70° 35′ W.; North Atlantic; 300 miles off the Chesapeake; depth, 2425 fathoms; bottom, blue mud; bottom temperature, 36°·8.

Length, 25 mm. (1 in.).

Station 232, May 12, 1875; lat. 35° 11′ N., long. 139° 28′ E.; off Japan; depth, 345 fathoms; bottom, green mud; bottom temperature, 41°·1. One specimen; female. Both trawl and dredge used.

Length, 50 mm. (2 in.).

Station 173, July 24, 1874; lat. 19° 9′ 35″ S., long. 179° 41′ 50″ E.; off Matuku, Fiji Islands; depth, 315 fathoms; bottom, coral mud. One specimen; male. Dredged.

Length, 24 mm. (1 in.).

Station 159, March 10, 1874; lat. 47° 25′ S., long. 130° 22′ E.; south of Australia; depth, 2150 fathoms; bottom, Globigerina ooze; bottom temperature, 34°·5. Three specimens; one male and two females. Trawled.

Length, 43 mm. (1·7 in.).

On May 6–18, 1876, in lat. 32° 41′ N., long. 36° 6′ W., at the last recorded Station of the voyage, one specimen was taken at the surface; and on the 7th of the same month, near the Azores, the locality whence Milne-Edwards' type of the species was taken by M. Reynaud nearly sixty years ago, two other specimens were taken at the surface. These were about 20 mm. in length and beautifully transparent.

Milne-Edwards records it from the Atlantic Ocean, near the Azores; and Kröyer from Greenland.

The preceding description is that given by Kröyer, and corresponds with the specimens taken by the Challenger in tropical and subtropical parts of the Atlantic.

Milne-Edwards[1] in his description of the species, says—"Third joint of the peduncle of the superior antennæ at least as long as the preceding."

The dorsal surface of the animal is smooth and even, except for a small pointed

[1] Hist. Nat. Crust., vol. ii. p. 428.

rostrum that is elevated rather than projecting forwards. The carapace is about one-third of the length of the animal, excluding the telson, and deepens laterally as it recedes from the frontal margin.

The five anterior somites of the pleon are subequal, but the sixth is about as long as two of the preceding somites, about half as deep as long, and three or four times longer than the telson.

The ophthalmopoda are short, not reaching beyond one-half the length of the first joint of the peduncle of the first pair of antennæ, and support an ophthalmus that is considerably larger in diameter than the stalk.

The first pair of antennæ (Pl. LXVIII., *b* ♂) has the peduncle nearly as long as the carapace, having the first joint broad, flat, and straight on the inner, but arched and furnished with a sharp tooth on the outer margin; both margins are fringed with ciliated hairs, the inner more sparsely. The second joint is nearly as long as the first, and the third is nearly equal to the first and second together. The second and third are narrow, cylindrical, and sparsely fringed with short ciliated hairs. The third joint carries at its distal extremity two flagella; the primary is long and slender, carrying at its base a large bulbous swelling, formed by the coalescence of several annuli; it is larger in the male than in the female, and in both sexes carries a series of closely-planted, membranous cilia, disposed in transverse rows, more numerous in the male than in the female. The rest of the flagellum is made up of numerous small, almost naked, articuli, there being only one very minute hair attached to each articulus near the distal extremity. According to Kröyer, the second pair of antennæ reaches to about the same length as the animal, but according to Milne-Edwards' figure[1] it is twice the length of the animal; in all the specimens in the Challenger collection the flagellum is broken off at various lengths. The outer or secondary branch in the female is short and rudimentary, having the articuli feebly represented, but in the male it is robust at the base, and at the third articulus sends off a short branch that is stout at the base, but rapidly narrowing, and supporting a long, curved spine, which seems capable of acting as a prehensile organ; the main stalk is still robust, and for some distance is apparently uniarticulate, and on the inner side of its distal extremity is developed into a large tubercle, studded at the summit with minute points; the succeeding articuli are narrow and cylindrical, each successively becoming smaller, so that the terminal portion, which measures about the same length as the basal portion, gradually tapers to the extremity.

The second pair of antennæ (Pl. LXVIII., *c*) has a strong peduncle and a small and slender flagellum, which, according to Kröyer, is once, and according to Milne-Edwards more than twice, longer than the animal, and supports a scaphocerite that is not of greater diameter than the last joint of the peduncle, but three times as long and gradually tapering to a point. The inner margin is fringed with long, strong, delicately

[1] *Ann. d. Sci. Nat.*, tom. xix., pl. x.

ciliated hairs, which are articulated at the base on small bulbous prominences; the outer margin is straight, free from hairs, and produced to a short tooth at the distal extremity.

The mandible (*d*) is small but robust; the incisive margin is concave, smooth, and projects anteriorly and posteriorly into a sharp tooth; it carries a two-jointed synaphipod, the basal joint being long and narrow, and the distal one about half the length of the first and somewhat narrow.

The oral appendages exhibit nothing very distinguishable from those of other species; the first pair of siagnopoda or maxillæ (*e*) consists of three plates; the inner is broad, foliaceous and armed with small spine-like hairs; the median is broad, becoming broader at the distal extremity, and is furnished with small robust spines on the inner margin and with a few hairs on the distal; the outer plate is small and rudimentary and tipped with only two hairs.

The second siagnopod (*f*) consists of four foliaceous rami and a broad mastigobranchial plate. The three inner are foliaceous, broad at the distal extremity, and fringed with stiff hairs; the central plate is subfoliaceous, and appears to be homologous with the typical appendage; it is narrow, somewhat robust, shorter than the other plates, and is tipped with three strong teeth or spines. The mastigobranchia is foliaceous and of extreme tenuity; it reaches forwards in advance of or to the same level as the distal extremity of the other plates, and expands posteriorly into a broad and extended plate, fringed all round with cilia that radiate at right angles to the curved margin.

The third siagnopod (*g*) or first maxillipede consists of two foliaceous plates and one triarticulate, cylindrical branch; the inner plate is long, broad, and of nearly the same breadth to the extremity, which is rounded; the inner margin is fringed with hairs and the outer smooth. The outer foliaceous plate appears to spring from the same base as the inner; it is also subequally broad to the rounded extremity, except upon the inner side near the base, where the triarticulate branch originates; this latter branch is cylindrical, or nearly so, and reaches a little beyond the two plates. Attached to the coxal joint by a small pedicle is a broad, smooth-margined, membranous, mastigobranchial appendage.

The first pair of gnathopoda is only six-jointed. The coxa is short and thick, the two succeeding joints are long, cylindrical and subequal, the next two are genuflexed upon the two preceding; all the joints are fringed with small fine hairs on the lower and outer side, and the terminal joint, which is broad, flat, and truncated, has the distal margin fringed with hairs.

The second pair of gnathopoda is much longer than the first, and consists of six joints, which gradually diminish in size as they succeed each other, the distal joint being strongly fringed with hairs.

The first pair of pereiopoda is slender, feeble, and shorter than the second pair of

gnathopoda; it consists of six joints, of which the first three are short and robust, the meros is long and slender, the carpos long and cylindrical, and the propodos or terminal joint is long, much more slender than the preceding, and strongly fringed with hairs. The two succeeding pairs of pereiopoda are seven-jointed; they are formed on the same general type as the first, but longer and a little more robust, and terminate in a minute chela of almost microscopic dimensions, which is all but hidden by the surrounding cilia. The fourth pair of pereiopoda in Kröyer's specimen is six-jointed, tolerably robust, and furnished with long hairs on the three distal joints. In the Challenger specimen, however, the fourth and fifth pairs of appendages are in only a young or rudimentary condition, which can scarcely be the result of an immature stage, seeing that in the male animal the prosartema is developed and the animal apparently possesses functional power. I can therefore only assume that, after the animal has arrived at maturity, the posterior two pairs of pereiopoda increase in value and importance without ever attaining any functional power. The posterior pair is in a more feeble condition than the fourth.

The pleopoda are short and robust. The first pair in the female is single-branched and simple; all the others are biramose. In the male the first (Pl. LXIX., *p*, *p*) carries on the inner side, near the middle, attached to a pedicle, a large, membranous petasma, that is united in the median line with a corresponding one on the opposite appendage by a series of small cincinnuli. The second pair of pleopoda (*q*) is biramose, and in the male has the anterior or inner branch developed at the base into a strong lobe that is serrate at the free extremity. The third pair is also biramose, and carries a lobe at the base of the inner branch, but is not serrate. The succeeding pairs are biramose, simple, but become shorter and more robust posteriorly.

The sixth pair, which forms the outer plates of the rhipidura, has the outer branch about one-third longer than the inner; the outer margin is armed with a small sharp tooth, distant about one-third from the apex; from this tooth the margin rapidly tapers to the distal extremity, and is fringed with short, soft hairs, that lengthen a little as they approach the apex, which is slightly truncated and furnished with three or four long, ciliated hairs, continued in gradually diminishing size upon the inner margin until they approach the base of the plate. The inner branch or plate is narrower than the outer, and gradually tapers from the base to the distal extremity; the inner and outer margins are fringed with ciliated hairs that gradually increase in length from the base to the apex.

The telson is about half the length of the inner branch; it is lobed on each side near the base, and then gradually tapers to a slightly truncated extremity, the margin being fringed with ciliated hairs that gradually increase in length from the base of the telson to the apex.

Sergestes arcticus, Kröyer, agrees in its general form with *Sergestes atlanticus*,

Milne-Edwards (*Sergestes frisii*, Kröyer), but differs in the relative measurements of several parts. The peduncle of the first pair of antennæ is according to Kröyer nearly a seventh ("septima ferme parte") shorter than the carapace in *Sergestes atlanticus*, and a third shorter ("tertia parte brevior") in *Sergestes arcticus*.

The peduncle of the second pair of antennæ has the terminal joint in *Sergestes atlanticus* scarcely the sixth of the length of the scaphocerite, while in *Sergestes arcticus* it nearly equals the third part.

The sixth somite of the pleon in *Sergestes atlanticus* is "scarcely the sixth of the length of the animal," and much shorter than the length of the fourth and fifth somites united, and about one-fourth longer than the telson. In *Sergestes arcticus* the sixth somite of the pleon is about "one-fifth the length" of the animal, surpassing the length of the fourth and fifth somites united, and nearly twice the length of the telson.

A careful and close analysis of the species named by Milne-Edwards *Sergestes atlanticus* and by Kröyer *Sergestes frisii* and *Sergestes arcticus*, has induced me to place them as synonyms of one and the same species. I have in the preceding paragraph given the points of difference which Kröyer takes to be of sufficient importance to justify their being considered separate species. If one compares Kröyer's figure with that of Milne-Edwards which was published so far back as March 1830, it will be seen the differences are not very important, and I feel certain that I shall receive the approval of future observers for uniting them. Kröyer's specimen, *Sergestes frisii*, was about 13 mm. in length, and Milne-Edwards' specimen of *Sergestes atlanticus* was 30 mm. long.

Mr. Sidney Smith gives a species of *Sergestes arcticus* as being 90 mm. in length.

The largest of the specimens of *Sergestes atlanticus*, from a dozen different places, in the Challenger collection is 50 mm., and the smallest perfectly developed male specimen in the collection is 24 mm.

If the animal so varies in length after it has attained adult sexual features, I think we may also assume that with successive moultings in time a greater or less variation may take place in the proportion of parts in relation to each other, for if the relative value of one part to the others be constant there could scarcely be room for the origination of species.

Sergestes dorsispinalis, n. sp. (Pl. LXXII. fig. 1).

Carapace rather more than one-third of the length of the animal. Rostrum short, sharp-pointed, and horizontal. Cervical suture well developed, and situated halfway between the frontal and posterior margins; just anterior to the suture, in the median dorsal line, is a small, anteriorly directed tooth.

Pleon with the four anterior somites dorsally smooth and subequal in size; the

fifth a little longer; ventral surface with no conspicuous prominence in the median line. Sixth somite equal in length to the four preceding combined, and slightly projecting posteriorly on the dorsal surface.

Telson about half the length of the rhipidura, armed at the extremity with two teeth, one at each angle and one small one on the lateral margin.

Ophthalmopoda quite half the length of the carapace, slender, clavate.

First pair of antennæ having the peduncle quite as long as the carapace, the first joint the same length as the ophthalmopod, and furnished with a short stylocerite and a circular otocyst; the second and third subequal, the two together being about equal in length to the first.

The second pair of antennæ has the terminal joint of the peduncle reaching to two-thirds the length of the ophthalmopod, and the scaphocerite as far as the middle of the third joint of the peduncle of the first pair of antennæ.

The mandible has a two-jointed synaphipod, of which the first joint is very long and the second short.

The first pair of gnathopoda is tolerably robust, but the second, though long, is slender. The pereiopoda are also long and slender, the chelæ of the third and fourth pairs being rather long. The fourth and fifth pairs are in a rudimentary condition, the fourth being considerably longer than the fifth.

The first pair of pleopoda is long and slender; the others rapidly decrease in length posteriorly. The terminal pair, which forms part of the rhipidura, has the outer margin furnished with a tooth about one-third distant from the extremity, on a level with the end of the inner branch.

Length, 9 mm. (0·3 in.).

Habitat.—South of Australia, March 1874.

This species is thus named because it has a tooth on the dorsal surface of the carapace. That this tooth should be solitary is remarkable, but the closest inspection has failed to show the presence of a second, which not infrequently exists in some species. Neglecting the value of the dorsal tooth, the animal approximates to *Sergestus corniculum*, from which, however, it further differs in the greater length of the ophthalmopoda and antennæ, as compared with Kröyer's figure and description, which more closely resembles the figure of *Sergestes corniculum* given on Pl. LXXV. fig. 1 of this Report.

Sergestes laterodentatus, n. sp.

Carapace one-fourth of the length of the animal, including the telson and excluding the rostrum. Rostrum long, slender, and horizontally straight, half as long as the carapace. Frontal margin armed with a tooth just above the first pair of antennæ, or between it

and the second. Lateral walls armed with a long tooth over the anterior portion of the branchial region.

Pleon with the three anterior somites smooth and subequal; the fourth and fifth of equal length, but dorsally elevated posteriorly, and each bearing a slender tooth. The sixth somite is as long as the three preceding combined, but not so deep, and is armed at the postero-dorsal margin with a long, slender tooth, and a small point exists at the postero-inferior lateral angles.

Telson long and slender, half the length of the sixth somite, and terminating in a sharply pointed fork, flanked by two small teeth.

Ophthalmopoda clavate, about two-thirds the length of the carapace, or a little longer than the first joint of the first pair of antennæ.

First pair of antennæ having the first joint of the peduncle broad at the base to receive the otocyst, and armed with a strong tooth on the outer margin; the second and third joints are subequal, and together of about the same length as the first; the third supporting one long and one short flagellum; the longer is about half the length of the animal, and the smaller about the length of the terminal joint of the peduncle.

The second pair of antennæ has a sharp tooth on the outer distal angle of the penultimate joint of the peduncle, and the terminal joint is about two-thirds the length of the ophthalmopoda (the flagellum is lost). Scaphocerite as long as the peduncle of the first pair of antennæ, armed on the outer margin, near the apex, with a strong tooth, and fringed on the inner margin with a series of hairs.

The first pair of gnathopoda is generic in appearance, and terminates in a small, flat, ovate, spatuliform joint.

The second pair is very long and slender, and terminates in a few long and strong hairs.

The first pair of pereiopoda is simple, the second and third long and chelate, and the fourth and fifth rudimentary.

Pleopoda long and slender, slightly shortening posteriorly; ultimate pair with a strong tooth at the outer distal angle of the basal joint; the inner branch as long again as the telson, the outer about one-fifth longer than the inner, and armed with a tooth on the outer margin, about two-fifths distant from the extremity, the intervening space to the apex being concave and fringed with hairs, as is also the inner margin.

Length, 8 mm. (0·33 in.).

Habitat.—South of Australia, March 1874. One specimen.

Observations.—This species was taken associated with *Sergestes dorsispinalis*, from which it materially differs in having no tooth on the dorsal median surface, but one of great length on each side, on the lateral walls of the carapace, just above the apophysis of the mandibles; and in having a tooth at the dorsal extremity of the three posterior somites of the pleon.

The specimen under examination had been evidently approaching a period of moulting. Having been stained, the subjacent new tissue shows the new dorsal tooth of the sixth somite ready to take the place of the previous one, but shorter and less important, while that on the fifth is still less so, and that of the fourth appears to be wanting.

It closely resembles *Sergestes longirostris* (Pl. LXXV. fig. 3), which was taken off Samboangan, from which, however, it differs in the presence of the two very long dorso-lateral teeth.

Sergestes cornutus, Kröyer.

Sergestes cornutus, Kröyer, Monograph. Fremstilling af Kræb. Sergestes, pp. 33, 61, Tab. ii. fig. 2, *a–l*.

"Rostrum very prominent and acute, equal to or exceeding half the length of the ophthalmopod.

"Ophthalmopoda pyriform, much shorter than the first joint of the peduncle of the first pair of antennæ, having the ophthalmus not distinct from the pedicle and broader than long; the breadth being rather more than one-third of the length of the ophthalmopod, but the length not half that of the ophthalmopod.

"First pair of antennæ has the peduncle very slender and about one-seventh shorter than the carapace; third joint longer than the clavate first joint, and much longer than the second.

"Second pair of antennæ having the last joint of the peduncle linear, and nearly half the length of the scaphocerite.

"Sixth somite of the pleon nearly one-sixth of the length of the animal, but shorter than the fourth and fifth somites combined, or the first and second, very little longer than the telson, but twice as long as broad.

"Pleopoda having the branches long and slender, but the basal joint of the fifth pair only twice longer than broad.

"Rhipidura having the outer ramus armed with a tooth one-third distant from the terminal apex.

"*Habitat.*—Greenland" (Kröyer.)

I have not been able to determine any form that wholly corresponds with this species, but that which I have named *Sergestes nasidentatus* differs from it in the length of the ophthalmopoda, which are about four times the length of the rostrum, or subequal to the first joint of the peduncle of the first pair of antennæ. It was taken off the southern coast of South America, near the island of Juan Fernandez.

Sergestes nasidentatus, n. sp. (Pl. LXXII. fig. 2).

Rostrum produced to a sharp point, and armed on the upper surface with a distinct tooth, a little anterior to the frontal margin. Carapace about one-third of the length of the animal; dorsal surface depressed, with a groove over the gastric region.

Pleon with the dorsal margin smooth; the five anterior somites subequal, lateral margins rounded; sixth somite longer than the two preceding and rather deeper than the fifth, and postero-dorsally produced to a small tooth in a line with the dorsal surface.

Telson about one-half the length of the sixth somite.

Ophthalmopoda long, stout, and clavigerous, about two-thirds the length of the carapace. The ophthalmus is scarcely broader than the stalk, and reaches as far as the first joint of the peduncle of the first pair of antennæ.

The first pair of antennæ about as long as the carapace; first joint as long as the ophthalmopod, second about one-third the length of the first, third subequal to the second; the primary flagellum is slender, but as it is partially broken off its length cannot be determined. The base is enlarged to a bulb, which has a prominence at the distal extremity.

The second pair of antennæ has the terminal joint of the peduncle cylindrical, and more than half the length of the first joint of the peduncle of the first pair, and supports a scaphocerite that reaches beyond the extremity of the ophthalmopoda, is armed on the outer margin, at a short distance from the apex, with a small tooth, and has the inner margin fringed with long ciliated hairs.

The first pair of gnathopoda is rather slender, but not to an unusual extent.

The second pair is slender and long, but not so long as the third and fourth pairs of pereiopoda; the joints are all subequal, and fringed with rather long hairs, more thickly implanted on the flexible or posterior side than on the anterior.

The first pair of pereiopoda is not very much shorter than the second pair of gnathopoda, reaching quite as far as the extremity of the penultimate joint of the latter. The joints are subequal; there is a prehensile apparatus (fig. 2, *k*) near the last articulation, consisting of a fasciculus of short, stiff, distally serrate hairs or spines attached to the ultimate, and another bundle of short, stiff, simple hairs, to the penultimate joint; each set is curved towards the other. Beyond these, a little distance from each fasciculus, are two isolated spines or hairs, that are curved towards each other; these all meet when the limb is flexed, and form a tolerably efficient prehensile apparatus, which may be of a secondary sexual character. The second and third pairs are long, slender, and fringed with long and delicate hairs, implanted in opposite pairs, and perpendicular to the axis of the limb; each of those pereiopods terminates in a small chela, the fingers of which are tipped with a small brush of hairs. The fourth pair is short, scarcely

more than one-sixth the length of the preceding, and feeble in character. The fifth pair is about half the length of the fourth, and almost rudimentary.

The pleopoda are long and slender, but gradually shorten in length posteriorly; the first pair is single-jointed, the others biramose.

The sixth pair is long, and forms the lateral plates of the tail-fan, of which the outer plate equals the sixth somite in length, and is armed with a tooth on the outer margin, one-fourth distant from the distal extremity; the outer margin beyond is fringed with hairs, as is also the inner margin and both margins of the inner plate.

Length, 10 mm. (0·4 in.).

Habitat.—The Pacific Ocean (December 16, 1875), between Valparaiso and Juan Fernandez; in the towing net at a depth of 200 fathoms.

Sergestes diapontius, Spence Bate (Pl. LXXII. fig. 3).

Sergestes diapontius, Sp. B., *loc. cit.*, p. 194.

Rostrum short, prominent, sharp-pointed and directed obliquely upwards, and elevated a little above the dorsal surface of the carapace, which is about one-fourth the length of the animal, including the telson.

Pleon with the three anterior somites subequal in length and dorsally smooth. The next two are about the same length, and dorsally armed with a tooth a little within the posterior margin. The sixth somite is shorter than the two preceding combined, dorsally smooth, and less deep than the fifth. Telson nearly as long as the rhipidura. Ophthalmopoda less than half the length of the carapace; ophthalmus not broader than the distal extremity of the stalk, which gradually tapers to the base.

First pair of antennæ with the first joint of the peduncle short, about one-third the length of the ophthalmopod, the second twice as long as the first, and reaching quite to the extremity of the ophthalmopod, and the third nearly as long as the second, but narrower, and supporting a long, slender flagellum that reaches to about one-half the length of the animal. The base of this flagellum is slightly enlarged, and carries a brush of membranous cilia, and a small rudimentary secondary flagellum.

The second pair of antennæ has the terminal joint of the peduncle broad, and longer than the first joint of the first pair, and reaching to nearly half the length of the second joint; scaphocerite nearly as long as the peduncle of the first pair, or reaching at least to half the distance of the third joint; flagellum long and slender, tapering to a fine thread, and nearly once and a half as long as the animal.

First pair of gnathopoda not specifically peculiar.

Second pair long and robust, being nearly as long as the animal; coxa, basis, ischium, and meros long and subcylindrical, carpos long and slender, rather longer than the meros, propodos shorter than the carpos, and divided into three or four articuli

or small joints, armed on the flexor surface with two or three long, strong, distally serrate spines, and several shorter ones (fig. 3, *i*).

The first pair of pereiopoda is short, not reaching beyond the distal extremity of the meros; it is five-jointed, slender, and furnished with a prehensile brush (fig. 3, *k*) at the carpal articulation of the meros; the carpos or terminal joint is more slender than the preceding and is straight. The second and third pairs are long and slender, but not so long as the second pair of gnathopoda, and terminate in small chelæ, each finger of which is tipped with a brush of radiating hairs. The fourth pair of pereiopoda is short, about half the length of the third pair, reaching to the distal extremity of the meros, and is fringed on the posterior margin with long hairs.

The fifth pair is shorter and more slender than the fourth, reaching to about one-half its length.

The first pair of pleopoda is short and single-branched; the second is equally short but double-branched; the three posterior are subequal in length but more robust; the posterior pair is short and devoid of a tooth on the outer margin of the external plate, which is fringed with a series of small hairs.

Length, 18 mm. (0·7 in.).

Habitat.—The Atlantic Ocean, April 7, 1876.

Observations.—This species bears a resemblance to *Sergestes ancylops*, Kröyer, but differs from it in the length and form of the ophthalmopoda, the length and robust character of the second pair of gnathopoda, the shortness of the sixth somite of the pleon, the absence of a tooth on the outer plate of the rhipidura, and in the length of the telson.

In the middle of the Pacific, north of the Sandwich Islands, several specimens of *Sergestes* in various stages of progressive growth were taken, and among them was one 2·5 mm. in length, which agreed with this species in all details, except that it had a long and slender rostrum. Another specimen, 3 mm. in length, differed only in the length of the rostrum, and a third, 4 mm. in length, corresponds with the Mastigopus shown on Pl. LXV. fig. 4, with which the two preceding also agree in all details, except in the dorsal teeth on the pleon and in the length of the rostrum, which in the two smaller specimens has a few denticles or teeth towards the extremity. Whether the larger belong to the same species as the two smaller it is difficult to determine, but the resemblance of the smaller to this species has induced me to draw attention to them in this place. The larger form appears rather to be the young of *Sergestes oculatus*.

Sergestus armatus, Kröyer (Pl. LXXIII. fig. 1).

Sergestes armatus, Kröyer, Monograph. Fremstilling af Kræb. Sergestes, pp. 44, 63, Tab. iii. fig. 6, *a–e*.

"Rostrum distally prominent, acute, fully half the length of the ophthalmopod.

"Ophthalmopoda long, reaching considerably beyond the second joint of the first pair of antenna, broadly clavate or subfungiform, ophthalmus very distinct from and nearly as wide as half the length of the ophthalmopod, and as long as one-third of it.

"First pair of antennæ having the peduncle one-half the length of the carapace, or one-fifth of that of the animal, with the first joint lamellar and nearly equalling the third in length, both being longer than the second.

"Second pair of antennæ with the scaphocerite four times longer than the last joint of the peduncle and extending nearly as far as the extremity of the peduncle of the first pair.

"Second, third, fourth, and fifth somites of the pleon armed each on the dorsal surface with a sharp tooth; sixth somite one-seventh of the length of the animal, longer than the fourth and fifth somites combined, longer than the telson, and equal to the first and second somites united; not quite twice as long as it is broad.

"Pleopoda very slender.

"Rhipidura with the external plate armed with a small tooth on the outer margin, nearer the base than the apex."

Length, 8 mm. (0·3 in.).

Habitat.—September 12, 1875, between Japan and Honolulu, South Pacific Ocean.

Station 256, July 21, 1875; lat. 30° 22′ N., long. 154° 56′ W.; north of the Sandwich Islands; depth, 2950 fathoms; bottom, red clay; bottom temperature, 35°·2.

"Greenland" (Kröyer).

Port Jackson, Australia, at night.

The rostrum is waved and produced to a length equalling half that of the ophthalmopod; the carapace, without the rostrum, is about one-third the length of the animal.

Pleon with the first five somites subequal, the fifth being rather the shortest; the first is smooth; the second, third, fourth, and fifth are armed with a long slender dorsal tooth, situated in front of the posterior margin; the sixth somite subequal to the two preceding, and about as deep as half its length.

Telson (fig. 1z) about half the length of the sixth somite, broad at the base and gradually tapering to the extremity.

The ophthalmopoda are long, and have the stalk slender, and the ophthalmus broad and reaching to the extremity of the first two joints of the peduncle of the first pair of antennæ.

The first pair of antennæ (fig. 1*b*) has the peduncle about two-thirds the length of the carapace, and its three joints subequal. The longer flagellum is broken off in all our specimens, but Kröyer states that it is about two-thirds the length of the animal, and is furnished with a small, rudimentary, secondary branch.

The second pair of antennæ is broken off in our specimen at the extremity of the peduncle, and Kröyer gives it as deficient also; it carries a long, narrow scaphocerite, about as long as the peduncle of the first pair of antennæ, and has the margins nearly parallel, the inner being fringed with ciliated hairs and the outer smooth and armed at the distal extremity with a small tooth.

The oral appendages were not specially examined.

The first pair of gnathopoda does not differ from the typical form.

The second pair is long and slender, being about three-fourths the length of the body of the animal; all the joints except the coxa are subequally long and slender, the two distal joints being fringed with long hairs.

The first pair of pereiopoda is short, being scarcely more than half the length of the second pair of gnathopoda, and is furnished with a brush of short spine-like hairs on each of the adjacent surfaces of the carpo-propodal or ultimate articulation, which gives the appendage a feeble prehensile power. The dactylos of this pair of appendages is absent. The second and third pairs of pereiopoda are slender, about as long as the first pair of gnathopoda, fringed with tolerably long hairs, and terminate in small chelæ. The fourth and fifth pairs are more rudimentary in the Challenger specimens than in Kröyer's figure, the animal probably being younger.

The pleopoda in the female specimen are moderately long and slender, except the sixth pair, which forms the outer plates of the rhipidura; the outer branch is rather more than twice the length of the telson, and is armed with a small tooth on the outer side about one-third from the base; from the tooth the margins gradually taper to the apex, and are fringed with long ciliated hairs.

Observations.—The dorsal surface of the carapace appears to be broader than is generally the case in this genus, but our specimen, from its small size, is probably not a full-grown animal. A specimen that appears to be a younger or Mastigopus form of this species was taken about 60° of west longitude of Station 256, but approximately in the same latitude. It is about 4 mm. in length, and differs chiefly in those features that are characteristic of a younger animal. The scaphocerite is longer and has the margins more nearly parallel than in Kröyer's figure, though not more so than in the animal represented in our figure. The telson and the plates of the rhipidura are narrower than in Kröyer's figure or in our type specimen. The dorsal surface of the pleon is armed with only three teeth, one on each of the three posterior somites, whereas *Sergestes armatus* is armed with four, one on the second, third, fourth, and fifth respectively, but none on the sixth. This difference in the dorsal armature is the

only feature that makes me hesitate to pronounce it to be a younger form of the latter species, which it may be and probably is, only just escaping from the Mastigopus stage; the second and third pairs of pereiopoda are just assuming their chelate condition. The animal from which our figure is taken is scarcely a mature one.

Sergestes edwardsii, Kröyer (Pl. LXXIII. fig. 2).

Sergestes edwardsii, Kröyer, Monograph. Fremstilling af Kræb. Sergestes, pp. 30, 61, Tab. iv. fig. 9 *a–k*.

" Rostrum rudimentary, directed obliquely upwards.

" Ophthalmopoda slender, shorter than the first joint of the peduncle of the first pair of antennæ. Ophthalmi not distinct from the pedicle, nearly as long as broad, and nearly one-third of the length of the ophthalmopod.

" First pair of antennæ having the peduncle about one-fifth shorter than the carapace: the third joint is rather shorter than the first and longer than the second.

" The second pair of antennæ has the terminal joint of the peduncle short, broad, subovate, and in length nearly equal to one-third of the scaphocerite.

" Sixth somite of the pleon about one-sixth of the length of the animal, or as long as the fourth and fifth somites together, or as the first and second united; about twice as long as broad, and scarcely one-third longer than the telson; inferior margin subangular.

" Pleopoda robust.

" Rhipidura having the outer ramus destitute of a tooth."

Habitat.—North Atlantic, April 1873.

Pacific Ocean, surface, September 1875;

Cape Verde Islands, April 26, 1876.

Greenland (Kröyer).

Length, 9 mm. (0·33 in.).

Rostrum small, pointed, slightly elevated anteriorly. Carapace less than one-third of the length of the animal.

Pleon having the dorsal surface smooth. The first five somites subequal; the sixth about equal to the two preceding.

Telson about as long as the rhipidura.

Ophthalmopoda short, gradually increasing from the base, and not reaching beyond the extremity of the first joint of the first pair of antennæ.

First pair of antennæ about two-thirds the length of the animal; the first joint a little longer than the ophthalmopod, the second shorter than the first, and the third a little longer than the first; the flagellum is about twice the length of the peduncle,

furnished at the base with a small lobe that carries a series of membranous cilia, and a small rudimentary second flagellum.

The second pair of antennæ (fig. 2*c*) is imperfect; it carries a scaphocerite that reaches nearly to the extremity of the peduncle of the first pair, and is long, narrow, and tapers very gradually to the distal extremity, which is armed laterally at the apex with a sharp tooth, and is fringed on the inner margin with long ciliated hairs.

The first pair of gnathopoda is short, slender, and feeble; it is armed on the upper side near the base of the ischium with a small, curved, or hook-like tooth, and furnished at the carpo-propodal articulation with a series of hairs, that, on flexion of the joint, assist in giving a feeble degree of prehensile power. The second pair is very long, being more than two-thirds of the length of the animal. The basal joints are very robust and long, and the terminal two slender, the ultimate being the shorter, and, like the preceding, fringed with hairs.

The first pair of pereiopoda is small and feeble, the second and third are slender, fringed with hairs, and terminate in small chelæ. The fourth is small and feeble, and the fifth rudimentary and inefficient.

The pleopoda are robust, but not very short, the fifth pair is the shortest, and of the greatest diameter. The sixth pair forms the lateral plates of the rhipidura; the outer or longer plate reaches but little beyond the extremity of the telson, and is fringed on the outer as well as on the inner side with a series of ciliated hairs, but does not carry a small tooth.

This species in its general aspect exhibits a close resemblance to *Sergestes atlanticus*, but may readily be distinguished from it by the absence of the tooth on the outer margin of the external plate of the rhipidura, and by the greater length of the telson.

The first pair of gnathopoda in *Sergestes atlanticus* has no armature of any kind, whilst in this species it carries a small tooth near the base on the upper surface, and a brush of prehensile spines at the carpo-propodal articulation. *Sergestes atlanticus* has been found from Greenland in the north to the Equator. *Sergestes edwardsii*, besides having been recorded at Greenland by Kröyer, has been found in the North and South Atlantic as well as in the Pacific Oceans.

Sergestes rinkii, Kröyer (Pl. LXXIII. fig. 3).

Sergestes rinkii, Kröyer, Monograph. Fremstilling af Kræb. Sergestes, pp. 49, 64, Tab. ii. fig. 3, *a–g*.

"Rostrum straight and short.

"Ophthalmopoda very long, reaching to the extremity of the second joint of the first pair of antennæ, but not beyond it, clavate, with the ophthalmus very distinct from the pedicle, its width equalling the third part of the length of the ophthalmopod.

"First pair of antennæ with the peduncle scarcely shorter than the carapace, exceeding

the fourth of the length of the animal, sublinear, slender; second and third joints subequal, but together much shorter than the first.

"Second pair of antennæ having the last joint of the peduncle elongated, linear, equalling in length a third of the scaphocerite, which is a little longer than the ophthalmopoda, very narrow, linear, straight, and ten times as long as broad.

"All the somites of the pleon are armed in the dorsal median line with a short tooth. The first and second somites carry merely small points, but the others are large, though soft and flexible. The sixth somite is elongated, sublinear, and about one-fifth the length of the animal, nearly equalling the combined lengths of the two preceding somites, and nearly four times as long as broad.

"Pleopoda elongated, very slender; the fifth pair shorter than but as slender as the others.

"Rhipidura having the outer branch armed near the middle of the external margin with a short tooth."

Habitat.—New Hebrides, August 23, 1874.

South Pacific, 1875.

Greenland (Kröyer).

Length, 8 mm. (0·3 in.).

The Challenger specimens are unfortunately very imperfect, but they undoubtedly belong to this species, although the localities are evidently distant from that given by Kröyer.

The rostrum is in a line with the dorsal surface of the carapace, small, but tolerably conspicuous. The carapace is about one-third the length of the animal. The pleon has the dorsal surface of the third, fourth, and fifth somites armed with a tooth situated at the posterior margin; the sixth somite is about as long as the united lengths of the two preceding somites. Telson (3z) about half the length of the rhipidura, and terminating in two long spines.

Ophthalmopoda subequal to the first two joints of the first pair of antennæ. The ophthalmus is broader than the stalk, projecting more above than below it.

The first pair of antennæ has the first joint longer than the other two. The longer flagellum is broken off.

The second pair of antennæ is also broken, and carries a scaphocerite that reaches nearly to the extremity of the peduncle of the first pair; it is fringed on the inner side with long ciliated hairs, and on the outer it is armed with a strong tooth, which, in our specimen, is very long, and is situated at some distance from the extremity, whereas Kröyer figures it as being at the extremity and extending beyond it.

Only the first pair of gnathopoda is preserved of all the appendages of the pereion, but it offers no feature of any specific value.

The pleopoda are long and slender; the first pair is single-branched, the others

biramose. The anterior pair is much the longest, while the posterior is the shortest. The outer plates of the rhipidura are armed on the outer margin with a small tooth, distant from the extremity about one-third the length of the plate; the margin beyond gradually tapers to the apex and is fringed with ciliated hairs.

Observations.—There are some points of difference between the Challenger specimen and the description and figure of Kröyer. The rostrum in the former is conspicuous for so small an animal, whereas Kröyer both figures and describes it as rudimentary. The ophthalmopod agrees with Kröyer's description, but differs from his figure in not having the eye symmetrically implanted on the stalk. The sixth somite is shorter than in Kröyer's figure, and although the telson in a general way resembles that given by him, it differs in minute details. Kröyer represents the telson as terminating in two long spine-like horns curving towards one another at the apex, but in the Challenger specimen the telson is cleft at the extremity into two lateral lobes, each of which terminates in a spine that distally curves towards the other, and besides these, there is on the inner side of each another small spine; there are also two others distally situated, one on each side of the telson (3z).

These are points that are not of any great value in specific definition and may be only features of immature growth. They are probably just those details that vary most in specimens from distant localities and lead to greater or less permanent changes of character.

Our specimens were taken in the South Pacific, and those of Kröyer within the Arctic zone.

Sergestes oculatus, Kröyer (Pl. LXXIV. fig. 1).

Sergestes oculatus, Kröyer, Monograph. Fremstilling af Kræb. Sergestes, pp. 27, 61, Tab. iii. fig. 5, *a–f*.

"Rostrum rudimentary.

"Ophthalmopoda longer than the first two joints of the peduncle of the first pair of antennæ, extending to about the extremity of the second, fungiform and supported on a long and slender pedicle. Ophthalmus short, somewhat dilated, and about one-fifth the length of the pedicle.

"First pair of antennæ having the peduncle one-fourth shorter than the carapace; the third joint as long as the first and one-fourth longer than the second.

"Second pair of antennæ having the scaphocerite four times longer than the last thick joint of the peduncle.

"Pereiopoda having the fourth pair scarcely natatorial. Sixth somite of the pleon one-fifth the entire length of the animal, as long as the fourth and fifth or as the first and second somites united; nearly twice as long as broad, and three times longer than the telson.

"Pleopoda very long and slender, except the fifth pair. Outer ramus of the rhipidura destitute of a marginal tooth."

Habitat.—Station 106, August 25, 1373; lat. 1° 47′ N., long. 24° 26′ W.; Mid Atlantic; surface to 40 fathoms. Four specimens.

Station 257, July 23, 1875, lat. 27° 33′ N., long. 154° 55′ W., about five degrees south of the Sandwich Islands. Whether it was obtained, as I am inclined to believe, in the towing-net near the surface, as most of the other specimens were, or at the recorded depth of the station (2875 fathoms), is not mentioned.

North Pacific, near the Sandwich Islands, August 21, 1875.

August 27, 1873. Six male specimens were taken at the surface, off St. Paul's Rock.

September 12, 1875. South Pacific, north of the Low Archipelago; a single specimen.

Station 103, August 22, 1873; lat. 2° 52′ N., long. 17° W.; Atlantic, south-west of Sierra Leone, at 100 fathoms. Recorded depth of Station is 2475 fathoms.

Greenland (Kröyer).

Length, 6 mm. (0·25 in.)

The specimen from which our figure is taken was captured in a tow-net at a depth of about 100 fathoms in the tropical part of the Atlantic, and corresponds closely with Kröyer's description of the species taken off Greenland.

The rostrum is rudimentary and not elevated above the dorsal surface of the carapace.

The pleon is smooth, with the five anterior somites subequal and the sixth a little longer than the two preceding somites combined, and terminating posteriorly in a small tooth.

Telson about half the length of the sixth somite.

Ophthalmopoda long and slender, terminating in a broad eye that reaches to the extremity of the second joint of the peduncle of the first pair of antennæ.

The first pair of antennæ (fig. 1, *b*) with the first two joints subequal, the third joint longer than the second, and the flagellum not enlarged at the base, but supporting a fasciculus of membranous cilia at a little distance from the extremity of the peduncle.

Second pair of antennæ (fig. 1, *c*) having the scaphocerite as long as the peduncle of the first pair of antennæ, furnished with a small tooth on the outer margin near the apex, and having the inner margin fringed with hairs (fig. 1, *c″*).

The first pair of gnathopoda has no peculiar feature.

The second pair of gnathopoda is long and robust, except the two ultimate joints, which are slender and straight.

The first pair of pereiopoda is short, about half the length of the second pair of gnathopoda. The second and third pairs are long and slender and terminate in small chelæ. The fourth and fifth pairs are feeble and rudimentary.

The pleopoda are slender but not long, increasing in diameter posteriorly. The sixth pair has the outer branch long, with the external margin straight, unarmed and smooth from base to apex, and the inner margin thickly fringed with long ciliated hairs; the internal ramus is one-third shorter than the outer and furnished with ciliated hairs.

In our specimen the second pair of gnathopoda has a peculiarity that is found in a few other species, in having the coxa largely increased in diameter. The value of this feature I have not been able to determine, but I think it is a character special to young male specimens previous to the development of more distinctly sexual characters.

This species closely approaches the two following.

At the surface of the China Sea a specimen about 7 mm. in length was taken, that corresponds with this species in all essential details, except that there is a little tooth only on the fifth and sixth somites of the pleon, the fourth somite being smooth. This variety differs from *Sergestes ancylops*, Kröyer, in having no tooth on the outer plate of the rhipidura.

Sergestes ovatoculus, n. sp. (Pl. LXXIV. fig. 2).

Rostrum short, slightly elevated above the line of the dorsal surface. Carapace more than one-third the length of the animal. Pleon having the anterior five somites subequal in length, the dorsal surface of the anterior four smooth, the fifth elevated into a strong prominence in front of the posterior margin, the apex of which is crowned with a small posteriorly projecting tooth. The sixth somite is equal to the combined lengths of the two preceding; it projects posteriorly in the dorsal median line to a blunt point, and has the lower margin fringed with ciliated hairs.

The telson is narrow, tapering, has the lateral margins fringed with numerous, long, ciliated hairs, and terminates in two small teeth.

The ophthalmopoda are about half the length of the carapace, or a little longer than the first joint of the peduncle of the first pair of antennæ. The ophthalmus is ovate, much broader than the stalk and abruptly enlarged to a fungiform shape.

The first pair of antennæ has the first joint of the peduncle as long as the stalk of the ophthalmopod, the second joint about half the length of the first, and the third nearly twice as long as the second; the longer flagellum is lost in our specimen.

The second pair of antennæ has the last joint of the peduncle terminating subequally with the first joint of the first pair; the flagellum is lost; the scaphocerite is narrow and nearly twice as long as the ophthalmopod, and is armed with a tooth near the distal extremity.

The first pair of gnathopoda is the only set of appendages of the pereion preserved, and offers no very distinguishing specific character.

The pleopoda are tolerably long, robust, and gradually shorten posteriorly.

The ultimate pair, which helps to form the rhipidura, is longer than the sixth somite of the pleon; the outer plate is narrow and has the external margin armed with a small tooth, about a third from the apex, beyond which it is fringed with ciliated hairs, as is also the inner plate.

Length, 10 mm. (0·4 in.).

Habitat.—The North Atlantic Ocean.

Observations.—This species corresponds very closely with *Sergestes oculatus*, Kröyer; the chief differences are that the outer margin of the rhipidura is armed with a tooth one-third distant from the apex, while in *Sergestes oculatus* it is smooth, and that the fifth somite has a tubercular, small-toothed prominence on the dorsal surface. *Sergestes parvidens* also possesses a close resemblance to this species, and demonstrates the affinity that these species have to one another, although they possess certain differential features that are characteristic of specific distinction.

Sergestes parvidens, n. sp. (Pl. LXXIV. fig. 3).

This species corresponds generally with the preceding; but instead of having only the fifth somite elevated to a dentate protuberance, there is one on the fourth, while the fifth bears a very minute tooth, as does also the sixth, which has the sides proportionately deeper than the preceding somites. The scaphocerite, instead of being rounded at the apex, narrows to a sharp tooth that arms the outer margin at the apex. The second pair of gnathopoda is wanting, but the pereiopoda, all of which are preserved, are long and slender, and correspond with those of *Sergestes oculatus*. The first pair (fig. 3, *k*) is furnished with distinct prehensile hairs situated near the ultimate articulation.

The outer plates of the rhipidura are much longer than the inner, and are fringed on both sides with fine hairs; the outer margin is not armed with a tooth as in *Sergestes ovatoculus*, but it is represented by an obtuse angle, about a fourth of the distance from the base, and defines the limit at which the marginal hairs begin.

Length, 9 mm. (0·36 in.).

Habitat.—The tropical part of the Atlantic; Pacific Ocean, north of the Sandwich Islands; off Sydney and Wellington, Australia.

Observations.—Specimens of this species or variety were taken during the passage from Teneriffe to St. Thomas; *Sergestes ovatoculus* was taken in the North Atlantic, June 14, 1873, and therefore near the same place; and *Sergestes oculatus* was taken among the Gulf-weed, and so far as geographical distribution is concerned, the Atlantic habitats of all these species are within the same region.

Kröyer has made the existence and position of the tooth on the outer margin of the

rhipidura a feature of importance in his description of species, and thus differs from Milne-Edwards, who has not even taken notice either of its presence or its absence in his typical species, *Sergestes atlanticus*. It appears to me that this tooth varies considerably in position according to the age of the specimen, and although in some species it may be either absent or more or less strongly developed in the adult, yet it certainly appears to travel towards the apex with advancing age, a change produced by the relatively greater growth of the appendage taking place at the base with each successive moult, so that with every exuviation the tooth gets more distant, and consequently appears to be nearer the apex.

North of the Sandwich Islands, in Mid Pacific, a specimen, 20 mm. in length, was taken that approaches very closely to this species, but it is much larger. It agrees closely with the figure given in Pl. LXXIV. fig. 3, but there is a very minute denticle on the rostrum which is not present in the typical specimen.

A specimen taken off Sydney, Wellington, Australia, 12 mm. in length, corresponds in almost every detail with the Atlantic form, so that it is impossible to separate them specifically, although the localities are so distant. In this specimen the little tooth which arms the outer plate of the rhipidura, is present on the right side and absent on the left, which consequently diminishes the interval between this form and *Sergestes oculatus*.

The young of this genus are frequently, if not always, tuberculated and spinous, while the adults are more generally smooth than denticulated, a circumstance that might suggest that *Sergestes ovatoculus* and *Sergestes parvidens* were immature forms of some one species; but when we consider their near approach in relative dimensions, I think I am, in the present state of our knowledge of the genus, justified in considering them as specifically distinct.

Sergestes corniculum, Kröyer (Pl. LXXV. fig. 1).

Sergestes corniculum, Kröyer, Monograph. Fremstilling af Kræb. Sergestes, pp. 36, 62, Tab. iii. fig. 4, *a–e*.

"Rostrum projecting forwards, very slender and acute.

"Ophthalmopoda subequal to or a little shorter than the first joint of the peduncle of the first pair of antennæ, clavate; ophthalmus very distinct from the peduncle, and about one-third or one-fourth of it in length; twice as broad as long, but the breadth not reaching one-half the length of the ophthalmopod.

"First pair of antennæ with the peduncle about one-fifth shorter than the carapace; the first joint is as long as the second and third combined.

"The second pair of antennæ with the last joint of the peduncle linear, and about one-third the length of the scaphocerite.

"The second pair of gnathopoda[1] at least two-thirds the length of the entire animal.

"Sixth somite of the pleon nearly one-fifth of the length of the animal, equal to the fourth and fifth somites combined, and nearly as long as the three anterior somites united; it is twice as long as broad and not much longer than the telson.

"Pleopoda very long and slender.

"Rhipidura having the external margin of the outer branch armed about midway with a sharp tooth, but rather nearer the base than the apex."

Habitat.—Cape York; north of New Guinea; North-West Pacific; Greenland (Kröyer).

Carapace about one-third the length of the animal. Rostrum horizontal, slender, but not very long, reaching to about one-third the length of the ophthalmopod.

Pleon having the five anterior somites subequal, and the sixth nearly equal to the united length of the three preceding; dorsal surface unarmed, excepting that the posterior margin of the ultimate somite projects posteriorly as a small point. The sixth somite is about half as deep as long, and has the inferior margins fringed with ciliated hairs, which gradually increase in length and thickness posteriorly.

The telson is long, narrow, and tapers slightly to the extremity, which terminates in a small fork; the margins are thickly fringed with long ciliated hairs that are continuous to the extremity.

The ophthalmopoda are about one-half the length of the carapace, reaching as far as the extremity of the first joint of the peduncle of the first pair of antennæ. The ophthalmus is about twice the greatest breadth of the stalk.

The first pair of antennæ has the peduncle about as long as the carapace, and terminates in a slender flagellum that makes the entire organ equal in length to the animal; the first joint is the longest, and about equal to the second and third together; the second is only slightly shorter than the third; the third supports a long and slender flagellum that is enlarged at the base into a strong bulb, which supports a series of membranous cilia, and a small secondary feeble and immature branch.

The second pair of antennæ has the ultimate joint of the peduncle very long, equalling that of the first joint of the peduncle of the first pair, and supports a long and slender flagellum, a large portion of which is broken off, so that its length in the Challenger specimens cannot be determined. The scaphocerite is long and broad, reaching quite to the extremity of the second joint of the peduncle of the first pair of antennæ; the outer margin has a small tooth near the extremity, and the inner margin is fringed with strong ciliated hairs.

The first pair of gnathopoda is rather smaller than usual.

[1] *Pes maxillaris tertius bessem longitudinis totius animalis minime æquans*, in Kröyer's description, is undoubtedly homologous with the second pair of gnathopoda, and not with the third pair of maxillæ (or maxillipedes).

The second pair is long and well developed, being nearly three-fourths the length of the animal, but not especially robust; the terminal two joints are slender and fringed with hairs.

The first pair of pereiopoda is two-thirds the length of the second pair of gnathopoda. The upper margin of the ischium is armed with a small tooth, and a fasciculus of small hairs or spines is implanted at the propodal articulation of the carpos; it is fringed with hairs, those on the lower or posterior surface being very long, especially towards the base. The propodos is also ciliated on both sides, but the hairs are not so long. The second and third pairs of pereiopoda are long, quite as long as the second pair of gnathopoda, and have the carpos and propodos fringed with long hairs, which are elevated on small prominences that give these appendages a multiarticulate appearance; each terminates in a small rudimentary chela. The posterior two pairs are feeble, the penultimate reaching nearly as far as the extremity of the meros, while the ultimate is small and rudimentary.

The pleopoda are robust and tolerably long, gradually decreasing in length posteriorly, but not increasing in diameter, as they frequently do in various species.

The rhipidura is quite as long as the sixth somite of the pleon; the outer margin near the middle is armed with a very minute tooth, posterior to which it is fringed with strong, ciliated hairs, similar to those on the inner branch.

Length, 12 mm. (0·5 in.).

Observations.—The specimen from which I have taken the preceding description corresponds so closely with that of Kröyer, that I do not hesitate to identify them as being the same, even though the localities are so widely separated; yet under a moderate magnifying power there is a difference that must not be passed over. In Kröyer's figure the rostrum is shown to be horizontal, in the same line as the dorsal surface of the carapace; in that which I have described the rostrum is horizontal but it is elevated slightly on a crest above the dorsal surface, on which, above the orbital margin, a minute point exists which is only observable under 60 diameters magnifying power. So similar are all the other features that I am induced to believe that these details were probably not appreciable under a low magnifying power, and therefore not described as being present in Kröyer's typical specimen.

A specimen taken in the North Atlantic (April 29, 1876) has the rostrum more than half the length of the ophthalmopod, and the chelæ at the extremity of the second and third pairs of pereiopoda are not developed, as if the animal were still in an immature condition, which appears to be the state of Kröyer's specimen, if we may judge from his figure. In that which I have figured the chelæ are so minute as only to be determined by a considerable magnifying power, which may be the case with Kröyer's specimens also.

The specimens taken north of New Guinea have the rostrum short, as shown in Kröyer's figure.

Sergestes laciniatus, Kröyer.

Sergestes laciniatus, Kröyer, Monograph. Fremstilling af Kræb. Sergestes, pp. 58, 66, Tab. v. fig. 15, *a–e*.

"Rostrum straight, rudimentary.

"Ophthalmopoda reaching nearly to the extremity of the first joint of the peduncle of the first pair of antennæ, clavate; ophthalmus very distinct from the pedicle, very short, being about the fourth or fifth of the length of the ophthalmopod, and nearly twice as long as broad.

"First pair of antennæ has the peduncle a little shorter than the carapace; first joint subclavate, and nearly as long as the second and third together; the second distinctly longer than the third.

"Second pair of antennæ having the last joint of the peduncle sublinear, reaching to nearly half the length of the linear scaphocerite.

"Second pair of gnathopoda [1] equal in length to nine-tenths of the entire animal.

"Sixth somite of the pleon a fifth of the length of the animal, or equal to the first, second, and third somites united (much longer than that of the fourth and fifth somites together), and twice as long as broad.

"Pleopoda long and slender; basal joint of the fifth pair four times longer than broad. Rhipidura having the external branch furnished with a rudimentary sharp point on the outer margin, situated anterior to the middle."

Habitat.—Greenland (Kröyer).

Observations.—This species does not appear to differ from *Sergestes corniculum* in any marked feature. According to Kröyer the chief distinction lies in the length of the rostrum, which is rudimentary in *Sergestes laciniatus* and well defined in *Sergestes corniculum*, and in the ophthalmus being more distinct from the stalk in the former than in the latter. The author gives no figure of the animal as a whole.

I can recognise no specimen in the collection of the Challenger that corresponds with this description.

Sergestes ancylops, Kröyer (Pl. LXXV. fig. 2).

Sergestes ancylops, Kröyer, Monograph. Fremstilling af Kræb. Sergestes, p. 46, Tab. iii. fig. 8, *a–e*.

"Rostrum small but distinct.

"Ophthalmopoda generally much longer than the first joint of the first pair of antennæ, angular, with the pedicle slender, straight, or nearly so, with long ovate ophthalmus.

[1] *Pes maxillaris tertius longitudine* $\frac{8}{10}$ *totius animalis æquans* (*vide* note, p. 411).

" First pair of antennæ having the peduncle two-thirds the length of the carapace, and about the fifth part of the length of the animal (or a little longer); third joint longer than the first, distinctly clavate, and much longer than the second.

" Second pair of antennæ having the last joint of the peduncle linear, equalling half the length of the narrow scaphocerite.

" Sixth somite of the pleon exceeding a little the sixth part of the length of the animal, and nearly twice as long as broad, and one-fifth longer than the telson.

" Pleopoda long and slender.

" Rhipidura having the external margin armed with a sharp tooth, about one-third from the apex.

" Length, 4 mm. (0·16 in.)."

Rostrum horizontally continuous with the dorsal surface of the carapace.

Pleon having the five anterior somites subequal, the fourth and fifth being armed with a strong dorsal tooth, a rudiment of another tooth apparently existing on the third also. The sixth somite is about as long as the two preceding, and projects posteriorly at the dorsal margin into a small tooth.

The telson reaches to rather more than half the length of the rhipidura.

The ophthalmopod reaches beyond the extremity of the second joint of the peduncle of the first pair of antennæ. The ophthalmus is ovate and implanted obliquely on the stalk; the inner or extended portion is continuous with the inner or upper margin of the stalk, which causes the latter to appear arched.

The first pair of antennæ is imperfect, being broken off at the extremity of the peduncle. The second pair is also broken, but the scaphocerite is present and reaches to about two-thirds the length of the peduncle of the upper antennæ; it is narrow, with the margins almost parallel, fringed with cilia at the inner margin, and armed with a tooth at the outer angle of the apex.

The first pair of gnathopoda is generic in character. The second pair is long and powerful, but the terminal joint is slender and fringed with cilia.

The first pair of pereiopoda is about two-thirds the length of the others, which are a little less in length than the second pair of gnathopoda, feeble in character and fringed with hairs. The last two are rudimentary.

The pleopoda are slender but not extremely long, the fifth pair being the shortest and most robust. The sixth or ultimate pair, which forms the lateral portion of the rhipidura, is armed on the outer margin of the external plate with a feeble hair-like tooth, situated rather more than a third from the apex, beyond which the margin is furnished with hairs fringed with cilia.

Length, 7 mm. (0·3 in.).

Habitat.—New Hebrides; Pacific, July 20, 1875; Greenland (Kröyer).

Observations.—The specimen from the New Hebrides, which I have selected as belonging to this species, differs from Kröyer's description in having a small tooth or tubercle on the dorsal surface of the third somite of the pleon; in all other respects it corresponds very closely, and is probably a young one, or one not yet fully developed.

Sergestes longirostris, n. sp. (Pl. LXXV. fig. 3).

Rostrum long, slender, directed horizontally forwards in a line with the dorsal surface of the carapace, of which it is rather more than one-half the length. Carapace, not including the rostrum, about one-third of the length of the animal.

Pleon having the five anterior somites subequal, the three anterior dorsally smooth, and with the postero-lateral margins round; the succeeding two somites are dorsally armed with a tooth at the posterior margin, and the postero-lateral margin is also produced to a point, of which that of the posterior is the more prominent; the sixth somite is about equal in length to the three preceding somites united, and is dorsally furnished with a tooth at the posterior margin.

The telson is about half the length of the rhipidura, terminates in a forked extremity, and has on each side a small hair or spine.

The ophthalmopoda are long, reaching to the extremity of the second joint of the first pair of antennæ and passing beyond the extremity of the rostrum by the breadth of the ophthalmus, which is broader than the stalk, and gives the organ a clavate appearance.

The first pair of antennæ has the first joint the longest, the second a little shorter than the first, and the third a little shorter than the second. The long flagellum is wanting in our typical specimen, and the secondary branch is very rudimentary.

The second pair of antennæ has the flagellum also wanting, but the scaphocerite is long and narrow, as long as the ophthalmopod, has the margins parallel, and terminates in a rounded extremity, the outer margin being armed with a long tooth that is situated at some little distance from the extremity, and the inner margin fringed with long ciliated hairs.

The oral appendages have not been examined.

The first pair of gnathopoda is the only appendage belonging to the pereion that is preserved, and it exhibits no character of any specific value.

The pleopoda are moderately long and slender; the first pair being the most so, and the fifth pair the stoutest and most robust. The first pair is simple, the second and three following carry a small secondary ramus that becomes smaller in each succeeding pair, and is almost a rudimentary bud on the fifth pair. The sixth pair, forming the outer plates of the rhipidura, has the outer margin armed with a strong tooth near the middle, beyond which it is fringed with ciliated hairs, which are also present on the inner margin and on both margins of the inner plate.

Length, 6 mm. (0·25 in.).

Habitat.—Mid Atlantic, April 1876.

Observations.—The specimen has the appearance of being an immature animal, and but for the form of the ophthalmus and the length of the rostrum I should have thought it related to *Sergestes ancylops;* it is about twice its size, and differs in some other apparently important features.

Sergestes junceus, n. sp. (Pl. LXXVI. fig. 1).

Rostrum small and slightly elevated above the dorsal surface of the carapace, which is a little less than half the length of the animal exclusive of the telson.

Pleon with the first three somites subequal and dorsally smooth. The two succeeding subequal in length, and dorsally armed with an elevated tooth just in front of the posterior margin. Sixth somite rather longer than the three preceding combined, posteriorly produced to a small tooth, and with the lateral walls not deeper than those of the preceding somites.

Telson nearly half the length of the sixth somite.

Ophthalmopoda about one-third the length of the carapace, and reaching a little beyond the distal extremity of the first joint of the first pair of antennæ. The ophthalmus is not very large, and the stalk, which is slender, narrows at first suddenly, and then gradually to the base.

The first pair of antennæ is about half the length of the carapace; the first joint is longer than the other two, and reaches nearly to the extremity of the ophthalmopod; the second is about one-third the length of the first, and the third is shorter than the second, and supports a flagellum, which is broken, and a short rudimentary appendage.

The second pair of antennæ carries a long, narrow scaphocerite, which is armed on the outer margin at a little distance from the extremity with a long and slender tooth; the inner margin is fringed with ciliated hairs.

The oral apparatus is situated anterior to the centre of the carapace.

The first pair of gnathopoda is rather slender, and is only generic in character. The second pair is wanting, but the coxa is larger in diameter than that of the other limbs.

The first pair of pereiopoda is long and slender, and devoid of any prehensile apparatus. The second pair is long and slender, and is once and a half as long as the first pair, and terminates in a very minute chela. The third pair is broken off at the basis. The fourth and fifth pairs are merely rudimentary or bud-like.

The pleopoda are long and slender, slightly decreasing in length, and increasing much in diameter posteriorly. The posterior pair, which forms the outer plates of the rhipidura, is long and broad, about as long as the sixth somite of the pleon; the outer margin of

the external plate is armed with a small tooth, one-third distant from the extremity, and beyond that is fringed with hairs.

Length, 6 mm. (0·25 in.).

Habitat.—South Pacific Ocean.

Observations.—This specimen is evidently one of the group that connects *Sergestes* with *Leucifer*. The great length of the cephalon, the distance between the oral apparatus and the frontal margin of the carapace, and the reduction of the two posterior pairs of pereiopoda to a rudimentary condition, demonstrate its tendency to depauperisation in the direction of that genus.

Sergestes longispinus, n. sp. (Pl. LXXVI. fig. 2).

Rostrum long, slender, and sharp, dorsally armed with a small denticle a little in advance of the frontal margin, and about one-third the length of the carapace, which is about one-third the length of the animal.

Pleon with the five anterior somites subequal, and dorsally armed with a strong tooth; the two anterior teeth are small and anteriorly directed; the two succeeding long, perpendicular, and spine-like, and the fifth small and directed posteriorly; the sixth somite is equal to the united lengths of the three preceding, but not so deep laterally, and is dorsally armed posteriorly with a tooth that is directed backwards in a line with the dorsal surface, and one also at the postero-inferior angle.

The telson is long and slender, being more than half the length of the outer branch of the rhipidura.

The ophthalmopoda are fungiform and about as long as the carapace; the stalk is long and slender, and the ophthalmus much broader than the stalk.

The first pair of antennæ has the three joints of the peduncle subequal; the terminal flagellum is broken off short.

The second pair of antennæ has the last joint of the peduncle long and cylindrical, and the scaphocerite is long, narrow, and with parallel margins, the outer being smooth and armed near the extremity with a sharp, slender tooth, and the inner fringed with a series of ciliated hairs.

The first pair of gnathopoda is rather short, but not specifically peculiar.

The second pair of gnathopoda is long, with the basal joints robust, and the distal slender and furnished with fine hairs.

The first pair of pereiopoda (fig. 2*k*) is short, about half the length of the second pair of gnathopoda; the basis is armed with a small denticle or obtuse point, and the under or posterior margin bears a series of distantly placed hairs, as also does the meros; the terminal joints are furnished with closely placed hairs, and the ultimate is reduced to a

minute size. The second and third pairs are long, slender, and terminate in small chelæ. The fourth and fifth pairs are entirely absent.

The pleopoda are slender, not very long, and gradually become shorter and more robust.

The sixth pair of pleopoda is about as long as the sixth somite of the pleon; the outer margin of the external plate is armed with a small tooth halfway between the basal and distal extremities; the rest are furnished with long ciliated hairs.

Length, 12 mm. (0·5 in.).

Habitat.—Station 106, August 25, 1873; lat. 1° 47′ N., long. 24° 26′ W.; Mid Atlantic Ocean, within 40 fathoms of the surface.

Station 354, May 6, 1876; lat. 32° 41′ N., long. 36° 6′ W.; North Atlantic Ocean.

Observations.—The specimen from the former station appears to correspond with the genus *Acetes* in the absence of the posterior two pairs of pereiopoda, but I am inclined to think, from the presence of these appendages in a rudimentary condition in the specimen from the latter station, that their absence is owing to the early stage of development.

The telson is rather longer in the specimen from the tropical part of the Atlantic than in that from the North Atlantic, which also has the ventral surface produced to large lobes in the median line, the anterior two being each furnished with a short strong tooth.

Sergestes penerinkii, n. sp. (Pl. LXXVI. fig. 3).

Carapace about one-third the length of the animal; rostrum short, about one-fourth the length of the carapace, and projecting horizontally forwards; frontal margin not produced to a tooth at the outer angle of the orbit.

Pleon having the first two somites armed on the ventral surface in the median line with a strong, sharp tooth, broad at the base, and directed forwards; the second being more prominent than the first. The third, fourth, and fifth somites are dorsally armed with a strong tooth in the median line of the posterior margin, and on the ventral surface in the median line with a strongly projecting unarmed lobe. The sixth somite is furnished with a tooth on the posterior dorsal margin, and is about as long as the two preceding somites together.

Telson about half the length of the sixth somite.

The ophthalmopod is very nearly as long as the carapace, the stalk slender, and the ophthalmus broad.

The first pair of antennæ having the extremity of the peduncle reaching scarcely beyond the extremity of the ophthalmopod; the three joints subequal or nearly subequal in length.

Second pair of antennæ with a scaphocerite as long as the peduncle of the first pair, and armed on the outer margin subapically with a small tooth.

The first pair of gnathopoda is generic in character.

The second pair is long; the three proximal joints are long and robust, the next long and slender, and the terminal uniarticulate, slender, and fringed with hairs.

The first pair of pereiopoda is short, slender, and carries a small but strong curved process attached to the posterior margin of the ischium. The other pereiopoda are missing.

The pleopoda are long and slender, slightly shortening posteriorly.

The outer margin of the external plate of the rhipidura is armed with a tooth one-third from the base, and distally fringed with short hairs; the inner margin is fringed with long hairs, as are also both margins of the inner plate.

Length, 8 mm. (0·3 in.).

Habitat.—North Atlantic Ocean.

Observations.—This species bears a strong resemblance to *Sergestes rinkii*, Kröyer, but differs in the following points:—in having the rostrum one-third the length of the ophthalmopoda, or about one-fourth the length of the carapace, instead of being short and rudimentary; the ophthalmus planted obliquely on the stalk, instead of being symmetrically even (*vide* Kröyer's figure, pl. ii. fig. 3); a sharp, projecting, mesial tooth on the ventral surface of the first and second somites of the pleon, and an obtuse projection on the three following somites; the ophthalmopoda subequal to the peduncle of the first pair of antennæ, instead of not reaching beyond the extremity of the second joint; a small tubercular process attached to the posterior margin of the ischium of the first pair of pereiopoda, not present in *Sergestes rinkii* (Kröyer has figured the appendages separately); the terminal pair of pleopoda, which helps to form the rhipidura, armed on the outer margin with a sharp tooth that is nearer the basal articulation than is the extremity of the telson, while that of *Sergestes rinkii* is much nearer the distal extremity.

Sergestes fermerinkii, n. sp. (Pl. LXXVI. fig. 4).

Carapace rather less than a third of the length of the animal. Rostrum smooth, sharp and horizontal, about one-fourth the length of the carapace. Frontal margin produced to a sharp tooth at the outer orbital angle.

First somite of the pleon dorsally smooth and laterally furnished with a short anteriorly directed tooth or tubercle. Second somite subequal and smooth. Third, fourth and fifth dorsally armed near the posterior margin with a strong tooth; as is also

the sixth somite, which is nearly as long as the three preceding somites combined. The infero-lateral distal angle of each is rounded.[1]

Telson short, about one-third the length of the last somite.

The ophthalmopod is about three-fourths the length of the carapace; the ophthalmus much larger than the diameter of the stalk.

First pair of antennæ with the peduncle longer than the ophthalmopod; first joint largely developed at the base to receive the otocyst; the second and third joints nearly as long as the first.

The second pair of antennæ carries a scaphocerite that is longer than the peduncle of the first pair, narrow, with parallel margins, and armed on the outer or smooth margin with a long tooth, somewhat distant from the apex.

The first pair of gnathopoda is the only one preserved of the long appendages of the pereion.

The pleopoda are long and slender, and the terminal or sixth pair is armed on the outer margin with a tooth that is nearly a third distant from the basal joint.

Length, 5 mm. (0·2 in.).

Habitat.—Pacific Ocean, lat. 24° S., long. 148° W.

Observations.—This specimen bears a close resemblance to the Challenger specimen of *Sergestes rinkii*, which was also taken in the Pacific, but it differs in having the telson shorter, the tooth on the outer margin of the rhipidura nearer the base, and in having a strong tooth on the frontal margin of the carapace. It also differs from Kröyer's figure of *Sergestes rinkii* in having a longer rostrum, and in the form of the scaphocerite; in both these points it corresponds more with our figure of *Sergestes rinkii* than with Kröyer's. It differs from *Sergestes penerinkii* in having a frontal tooth at the outer canthus of the orbital notch, in not having any tooth or protuberance on the ventral median line of the somites of the pleon; and in the shorter telson.

Sergestes tenuiremis, Kröyer.

Sergestes tenuiremis, Kröyer, Monograph. Fremstilling af Kræb. Sergestes, pp. 39, 62, Tab. iv. fig. 11, *a–b*.

"Rostrum upright, rudimentary.

"Ophthalmopoda clavate, rather longer than the first joint of the peduncle of the first pair of antennæ, or at least equal to it; the pedicle slender, elongated, distinct from the ophthalmus, and more than twice as long. Ophthalmus nearly four times as broad as long, one-third the length of the pedicle, and in diameter scarcely less than a third.

"First pair of antennæ with the peduncle only a little longer than half the length of

[1] I have unfortunately drawn an extra somite to the pleon; there are only two smooth somites instead of three; the second should have been omitted.

the carapace; the third joint of the peduncle is subequal in length to the second, and the two together are equal in length to the first.

"The second pair of antennæ with the scaphocerite sublinear, and six times as long as broad; the last joint of the peduncle is linear, and three times as long as broad.

"Sixth somite of the pleon scarcely a sixth part of the length of the entire animal, but fully as long as the first and second somites together, scarcely shorter than the fourth and fifth somites together, more than twice as long as broad, and scarcely one-third longer than the telson; it is armed with a sharp point on the posterior dorsal margin.

"Pleopoda very slender, the anterior pair nearly subsetiform.

"Rhipidura having the external branch armed with a sharp point, about one-fourth distant from the apex.

"*Habitat.*—Greenland" (Kröyer).

Observations.—No specimen in the Challenger collection corresponds precisely with the description and figure given by Kröyer, but there are three forms that somewhat closely resemble it. Two were taken in the North Pacific, and one in the North Atlantic.

The one described as *Sergestes præcollus* was taken north of the Sandwich Islands. It corresponds most closely, but differs in having the rostrum reduced to a mere angle, and the ophthalmopoda slightly compressed behind the ophthalmus, the stalk gradually decreasing to the articulation; and carries a very long and outwardly directed tooth on the outer margin of the outer plates of the rhipidura, in the position mentioned by Kröyer.

Sergestes longicollus, n. sp. (Pl. LXXVII. fig. 1).

Rostrum reduced to a small point on the frontal margin. Carapace considerably more than one-third the length of the animal, little less than one-half, exclusive of the telson.

Pleon dorsally smooth; the four anterior somites subequal, the fifth a little longer than the preceding, all with the infero-lateral angles rounded off; sixth about twice as long as the fifth, posteriorly furnished with a small dorsal tooth.

Telson about half the length of the sixth somite.

Ophthalmopod one-fifth as long as the carapace, and reaching as far as the extremity of the first joint of the peduncle of the first pair of antennæ. Ophthalmus a little broader than the stalk, which gradually narrows to the base.

First pair of antennæ with the first joint as long as the ophthalmopod, the second joint about half the length of the first, and the third subequal to, or a trifle longer than, the second; flagellum wanting, secondary branch slender and feeble, and as long as the third joint.

Second pair of antennæ with the terminal joint of the peduncle cylindrical and

as long as the ophthalmopod, and supporting a scaphocerite that reaches beyond the distal extremity of the second joint of the first pair of antennæ; the outer margin is armed with a long, slender tooth, somewhat distant from the rounded apex, which is fringed with a series of fine hairs.

Oral apparatus situated halfway between the frontal and posterior margins of the carapace.

The mandible furnished with a long synaphipod, which does not reach to the frontal margin of the carapace.

The first pair of gnathopoda has the ischium and meros reaching but a little in front of the oral apparatus, and the whole of the appendage when extended scarcely reaches to the frontal margin of the carapace.

The second pair of gnathopoda is missing, being broken off at the coxa, which is broad and formed for carrying a powerful organ.

The first pair of pereiopoda is short as compared with the second and third, but not much shorter than the first pair of gnathopoda; the ischium and meros are long and robust, and the two terminal joints feeble and ciliated. The second and third pairs are long, slender, fringed with long hairs, and terminate in minute but long, fringed chelæ. The fourth pair is about half the length of the preceding, and fringed with long hairs on the posterior margin of the distal extremity. Fifth pair little more than half the length of the fourth, very slender, and fringed with hairs.

Pleopoda long and slender, gradually decreasing in length and increasing in breadth posteriorly.

Posterior pair having the outer branch nearly twice as long as the telson; outer margin straight and armed with a small tooth one-fourth distant from the extremity, beyond which the margin is fringed with short hairs, as also are the inner margin and both margins of the inner plate.

Habitat.—South Atlantic Ocean, October 5, 1873; near Station 131; lat. 29° 35′ S. long. 28° 9′ W.

Length, 25 mm. (1 in.).

Station 295, November 5, 1875; lat. 38° 7′ S., long. 94° 4′ W.; South Pacific Ocean; depth, 1500 fathoms; surface temperature, 52°·5. Taken at night.

Length, 8 mm. (0·3 in.).

Observations.—This species comes very near to *Sergestes tenuiremis*, Kröyer, but differs from it in the form of the rostrum, which is represented in Kröyer's figure as standing erect on the dorsal surface, but which in our specimen is reduced to a mere point on the frontal margin.

The specimen from the South Pacific is more pronounced than that from the South Atlantic, and the ophthalmopod corresponds more nearly with Kröyer's species.

Sergestes præcollus, n. sp. (Pl. LXXVII. fig. 2).

Very closely resembling *Sergestes longicollus*, but differing in certain details, of which the following are the most important.

The fifth somite of the pleon in *Sergestes præcollus* has the posterior margin dorsally produced to a point; the sixth somite is not produced to a point posteriorly.

The scaphocerite is broad and armed on the anterior margin with a subapical tooth; inner margin sparsely fringed with short hairs. The oral apparatus is a little in advance of the centre of the carapace.

The first pair of gnathopoda is rather more robust than in *Sergestes longicollus*, and is produced to a truncated tubercle at the posterior angle of the coxal joint.

The second pair of gnathopoda is tolerably long and robust; the distal joints are not more slender than the proximal, and are fringed with cilia.

The first pair of pereiopoda is two-thirds the length of the second pair of gnathopoda, and is not furnished with a prehensile apparatus at the ultimate articulation.

The third and fourth pairs of pereiopoda are subequal and terminate in a short and fringed chela.

The sixth pair of pleopoda has the outer plate furnished with a small tooth nearly halfway from the distal apex; the margin beyond the tooth being slightly excavated and fringed with hairs, also the inner margin and both margins of the inner plate.

The carapace in this, as in the preceding species, has the lower margin closely folded beneath the ventral surface and deepens posteriorly.

Length, 25 mm. (1 in.).

Habitat.—North Pacific Ocean.

Observations.—The specimen is one of those that corresponds closely with *Sergestes tenuiremis*, but differs from it and from *Sergestes longicollus* in the form of the posterior pair of pleopoda, which is armed on the outer margin with a tooth more distant from the distal extremity of the plate, and has the space beyond it slightly concave. These species and *Sergestes junceus* all agree with *Sergestes tenuiremis* in having the distance between the oral appendages and the antennal or frontal region considerably prolonged, and suggest an approximation to the genus *Leucifer*, with which name von Willemoes Suhm has labelled one of the specimens that was mounted for microscopic use.

Sergestes semiarmis, n. sp. (Pl. LXVII. fig. 1).

Rostrum sharp, straight, armed on the upper surface with a small tooth, and reaching to about half the length of the first joint of the peduncle of the first pair of antennæ. Carapace nearly a third of the length of the animal, having the frontal margin furnished with a strong tooth on the outer side of the first pair of antennæ.

Pleon having the five anterior somites subequal. The first two dorsally smooth; the three succeeding armed with a strong tooth on the posterior dorsal region. Sixth somite about the length of the two preceding combined, and with the postero-dorsal angle produced to an obtuse point.

Telson about half the length of the sixth somite.

Ophthalmopoda about two-thirds the length of the carapace, fungiform in appearance; ophthalmus broad, stalk narrow.

First pair of antennæ having the peduncle a little longer than the ophthalmopoda; first joint longest, second and third subequal, supporting a long and slender flagellum that is quite the length of the animal, and has a bulbous enlargement at the base, from which there usually springs a fasciculus of membranous cilia.

The second pair of antennæ support a similarly formed but rather longer, flagellum, and a scaphocerite that is equal in length to the peduncle of the first pair. It has the inner and outer margins subparallel, the outer being smooth and armed with a strong tooth near the distal extremity; the inner margin foliaceous and fringed with a thick row of ciliated hairs.

The first pair of gnathopoda possesses no specific character.

The second is long, robust at the base and slender towards the distal extremity, where it is fringed with hairs disposed in pairs, one on each side, the hairs supported on strong prominences, each alternately larger and smaller; the distal extremity is tipped with three long, strong, simple hairs.

The first pair of pereiopoda is about half the length of the second pair of gnathopoda; it is slender and feeble and carries a small prehensile organ. The second and third pairs are long and slender, and terminate in a small chela, the extremity of each digit being tipped with a small brush of hairs; the third pair has the fingers longer and more slender than the second. The fourth pair is short and very slender, reaching nearly to the distal extremity of the ischium of the third pair. The fifth or terminal pair is very much shorter than the fourth, and is rudimentary in character.

The pleopoda are slender but not long. The first pair is the most slender, and is single-branched; the others are biramose and become gradually shorter posteriorly; the posterior pair, which helps to form the rhipidura, has the outer and longer plate armed on the external margin with a strong tooth about midway between the base and the distal extremity, and the margin beyond is fringed with long ciliated hairs, as also is the inner plate.

Length, 12 mm. (0·5 in.).

Habitat.—West Pacific Ocean.

Station 354, May 6, 1876; lat. 32° 41′ N., long. 36° 6′ W.; Mid North Atlantic; surface temperature, 70°·0.

Observations.—A specimen (Pl. LXVII. fig. 2) very similar to the type was taken in

the Atlantic, the differences being so slight that they would not justify its separate notice from *Sergestes semiarmis*, but for the distance between their habitats.

This specimen has the scaphocerite long and narrow, the sides parallel, the outer smooth and armed with a long tooth at a point equal to its length from the extremity.

The first pair of pereiopoda is slender and exhibits no trace of a prehensile apparatus. The chela of the second pair of pereiopoda is minute and rudimentary, the pollex particularly so. The fourth and fifth pairs of pereiopoda are minute and bud-like, as if they were only commencing to be developed.

The sixth somite of the pleon terminates dorsally in a prominent tooth instead of in a blunt point as in the typical specimen, and the telson terminates in a minutely-forked extremity.

These two forms are, I believe, early stages of a much larger specimen, but their matured shape compels us to accept them as specific forms until the life-history of the species be made clear.

Sergestes læviventralis, n. sp. (Pl. LXVII. fig. 3).

Carapace more than one-third the length of the animal. Rostrum as long as the ophthalmopod, armed with a tooth immediately over the frontal margin.

Pleon armed with a tooth at the posterior dorsal surface of each somite, those on the anterior three somites being vertical, and on the posterior three directed backwards. The median ventral line of the pleon is free from spinous processes.

Telson about half the length of the sixth somite.

Ophthalmopoda clavate, not longer than the rostrum, robust; the ophthalmus but little larger than the diameter of the distal portion of the stalk.

The first pair of antennæ has the first joint of the peduncle rather longer than the ophthalmopod; second and third short, subequal, and together about the same length as the first.

The second pair of antennæ has the terminal joint of the peduncle reaching nearly to the extremity of the ophthalmopod, and carries a scaphocerite that reaches as far as the distal extremity of the peduncle of the first pair of antennæ.

The mandible is at a considerable distance from the antennæ, and is, I believe, furnished with a small two-jointed synaphipod, although in the present condition of the mounted specimen I could not positively determine it.

The first pair of gnathopoda terminates in a short spatuliform dactylos.

The second pair is long and slender, having the coxa larger than in any of the other appendages of the pereion.

The first pair of pereiopoda is slender and about half the length of the second

pair of gnathopoda. The second and third pairs of pereiopoda are long, slender and chelate. The fourth and fifth pairs are in a rudimentary or bud-like condition.

The pleopoda are long and slender, gradually becoming shorter posteriorly; the terminal pair, which forms the outer rami of the rhipidura, is armed with a strong tooth at about two-fifths from the distal extremity; the distal division is slightly curved inwards and furnished with many hairs similar to those on the inner margin.

Telson about half the length of the outer branch of the rhipidura and armed with two short, sharp teeth at the distal extremity, and with three similarly formed articulating spines on the lateral margin, of which the anterior is intra-marginal and separated considerably from the posterior two.

Length, 7 mm. (0·28 in.).

Habitat.—North of New Guinea (label VI. in Suhm's series).

Observations.—This species somewhat resembles *Sergestes spiniventralis*, but differs from it in having no large teeth on the median lobes of the ventral surface of the pleon; the outer ramus of the rhipidura is broader and armed with a strong lateral tooth, and the telson is longer and armed with lateral spines; but the most important structural difference appears to me to lie in the distance of the oral apparatus from the cephalic appendages, which is much greater in *Sergestes læviventralis* than in *Sergestes spiniventralis*.

Two specimens that correspond with Kröyer's description of *Sergestes corniculum* were taken associated with it; they are both 7 mm. in length.

Sergestes spiniventralis, n. sp. (Pl. LXVII. fig. 5).

Carapace about one-third the length of the animal. Rostrum long and slender, armed with a slight tooth above and slightly anterior to the frontal margin, which carries a well-developed tooth above the orbit; antero-lateral angle rounded and smooth. Carapace smooth except for a very small lobe above the mandible and a well-defined tooth in the median line at the posterior margin.

The first somite of the pleon is dorsally smooth except for a very minute tooth on the posterior margin, and ventrally produced in the median line to a large lobe, that is surmounted by a strong anteriorly directed tooth. The second somite is dorsally armed with a minute tooth on the posterior margin, and ventrally furnished with a strong lobe, surmounted by a strong tooth as in the first somite, but directed downwards. The third somite is dorsally armed with a strong tooth, perpendicular in direction, and ventrally furnished with a large lobe without being surmounted by any tooth. The fourth and fifth somites are similarly armed, but the teeth on the dorsal surface are directed backwards; and the ventral lobes are less prominent.

The sixth somite is as long as the three preceding combined, and is armed dorsally on the posterior margin with a horizontal tooth and with a small tooth at the postero-lateral angles, while the median ventral lobe is unarmed and reduced in size, and has the nerve-ganglion belonging to this somite lodged in it.

Telson about one third the length of the sixth somite, deep at the antero-lateral margin and narrow at the distal extremity, where it is armed with two sharp teeth.

Ophthalmopoda fungiform (fig. 5*a*), and nearly four times longer than the rostrum.

First pair of antennæ having the first joint of the peduncle a little shorter than the ophthalmopoda; the second joint about one third the length of the first, and the third about half the length of the second.

The second pair of antennæ has the last joint of the peduncle reaching to one third the length of the ophthalmopod, and the scaphocerite, which is narrow, with the margins parallel, and armed near the extremity with a sharp tooth, reaches as far as the distal extremity of the peduncle of the first pair of antennæ.

The epistoma is largely developed and projects anteriorly to near the posterior extremity of the antennæ.

The mandibles are strong, but I cannot detect a synaphipod attached.

The first pair of gnathopoda is similar to that in other species.

The second pair is attached to a large coxa and is robust as far as the fourth joint, the distal two being slender and fringed with hairs, and subequal in length with the animal.

The first pair of pereiopoda is short, slender, and is not furnished with a small tubercle on the anterior margin of the ischium. The second pair of pereiopoda is long and slender, and has the ischium furnished with a small tubercle. This pair terminates in a rudimentary or scarcely determinable chela furnished with long hairs. The third pair resembles the second in length and proportion, but has the ischium smooth and the terminal extremity without a trace of a chela, and is furnished with long hairs.

The fourth and fifth pairs are apparently missing.

The pleopoda are slender and decrease in length posteriorly.

The sixth pair, which forms the outer plates of the rhipidura, is long, narrow and pointed; the outer plate is longer than the inner, and nearly four times the length of the telson, it has no tooth on the lateral margin, and is slightly curved, and fringed with hairs that increase in length posteriorly.

Length, 3·5 mm. (0·14 in.).

Habitat.—North Pacific Ocean.

This species should be compared with *Mastigopus spiniventralis* (p. 379; Pl. LXVII. fig. 4), the specimen of which, with three others on the same slide, is labelled by Dr. v.

Willemoes Suhm as being the young of *Sergestes tenuis*, but what that species is I am not prepared to determine, as there is no adult in the collection thus named.

With it was taken the Acanthosoma form represented on Pl. LXIV. fig. 2 (*Acanthosoma tynitelsonis*), in which figure a large median lobe ought to be added to the ventral surface of the five anterior somites of the pleon, of which the three anterior are armed with a small tooth. A younger Acanthosoma that corresponds in certain details with *Acanthosoma macrotelsonis* (Pl. LXVI. fig. 1) suggests that they belong to separate species. The length of our type specimen is about 4 mm. The carapace has four lateral spinous teeth, but instead of being situated as in *Acanthosoma macrotelsonis* they are all close together and implanted nearer the fronto-lateral margin; the two anterior are small, close together, and correspond with the fronto-lateral angle of the carapace; the next is long, slender, and not remarkably spinous, and the next is somewhat similar and situated in a line a little posterior to the oral appendages. Behind this the rest of the carapace is smooth, as in figs. 1 and 3 on the same plate, from which it differs in having a long, slender, forked, and spinous telson. It corresponds with fig. 3, which Dr. Suhm considers to be a younger stage, in the form of the scaphocerite as well as in the outer branch of the rhipidura.

The specimen figured as *Mastigopus tenuis* on Pl. LXV. fig. 4, was also taken associated with *Mastigopus spiniventralis;* its length is about 5 mm. It was labelled by Dr. Suhm, whose name I have retained, as being the young of *Sergestes tenuis;* it is an older form, and has assumed the Mastigopus features, but they cannot belong to the same species, for in this one the rostrum is short and rudimentary, without a dorsal tooth; it is unarmed on the dorsal surface of the pleon, destitute of teeth on the median lobes of the ventral surface, and the outer branch of the rhipidura is not armed with a lateral tooth. These four forms were taken together, mounted and labelled by Dr. Suhm as the young of one species. Except for the large diameter of the eye, the specimen corresponds more closely with the description of *Sergestes edwardsii* than with any other species known to me.

Sergestes profundus, n. sp.

Carapace about one-third the length of the animal, anteriorly produced to a sharply pointed rostrum, and armed on the crest with one small tooth. Dorsal surface divided near the middle by the cervical fossa. First four somites of the pleon subequal in length, the fifth rather shorter than the preceding, the sixth as long as the fourth and fifth together.

The antennæ, gnathopoda, pereiopoda are lost, and the rhipidura is broken.

Length, 21 mm. (0·84 in.).

Habitat.—Station 137, October 23, 1873; lat. 35° 59′ S., long. 1° 34′ E.; depth, 2550 fathoms; bottom, red clay; bottom temperature, 34°·5. One female (?). Dredged.

Station 300, December 17, 1875; lat. 33° 42′ S., long. 78° 18′ W.; west of Valparaiso; depth, 1375 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·5. Female (?). Trawled.

The specimen unfortunately is very imperfect, but the form of the rostrum is not unlike that of *Sergestes spiniventralis* (Pl. LXVII. fig. 5). It consists of a short fine point projecting horizontally for about one-fourth the length of the ophthalmopod, and is dorsally furnished on the crest with a small tooth. The carapace generally is soft and flexible, particularly on the lateral walls.

The pereion has the pleural walls of each somite longitudinally divided as in *Sergestes prehensilis.*

The pleon is dorsally smooth, the first three somites are subequal in length, while the fourth is rather shorter than the third, and the sixth is subequal in length to the fourth and fifth together, and is laterally compressed and deeper than the preceding somites; on the dorsal surface it is armed posteriorly with a small projecting tooth.

The telson is about one-half the length of the sixth somite, laterally depressed near the base and tapers to the extremity, which terminates in three points, the middle being the longest.

All the appendages are lost or broken off short, excepting the pleopoda and the ophthalmopoda which are about one-fourth the length of the carapace, and have the ophthalmus not of larger diameter than the stalk.

The antennæ are broken off just beyond the extremity of the ophthalmopoda.

The mandibles carry a slender biarticulate synaphipod that reaches to the extremity of the ophthalmopoda, and has the inferior margins fringed with long hairs; the margin of the psalistoma is smooth. The metastomata are well developed and of a bat-shaped form, and the succeeding oral appendages correspond with those of *Sergestes prehensilis.*

The gnathopoda and pereiopoda are all lost, being broken off short at the coxal joint.

The pleopoda are perfect, the first pair being single-branched as in females, and the others biramose. The posterior pair, which forms the lateral rami of the rhipidura, is broken off at half its length, so that the form cannot be determined.

Observations.—The species of this genus mostly live within a hundred fathoms of the surface, but there is every reason to believe that this one resides near the bottom, it having been taken in the same haul together with the rhipidura of a specimen of *Gnathophausia ingens* and one of *Gennadas intermedius.*

The branchiæ, as well as could be observed, consist of a series of nearly circular discs attached to a common stalk, somwhat like those figured on Pl. LXV. fig. 3.

The structure of the external tissue is reticulate throughout, which is especially noticeable in the rhipidura and dorsal crest.

The rostrum corresponds somewhat to that of *Sergestes spiniventralis*, but the ventral surface is not armed with a series of projecting teeth.

North-east of the island of Juan Fernandez and about five hundred miles due west of Valparaiso, another specimen of *Sergestes* was trawled at a depth of more than a mile and a half, associated with specimens of *Willemœsia*, *Pentacheles*, and *Glyphocrangon*. It is a mutilated specimen, but the existing parts correspond with those preserved of *Sergestes profundus*, and as they are the only specimens in the collection that are recorded from so considerable a depth, they are probably of the same species, and the description of one may interpret the form of the other. The portion of the animal preserved is as far back as the extremity of the second somite of the pleon with the appendages, but the body is too compressed and disfigured to say more than that it is generally free from external adornment.

The rostrum is similar to that of the specimen from Station 137, and corresponds in form, but in a less pronounced degree, with that of *Sergestes spiniventralis*.

The ophthalmopoda are about one-fourth of the dorsal length of the carapace, and somewhat clavate, but the ophthalmus is not of greater diameter than the stalk.

The first pair of antennæ has the first joint of the peduncle longer than the ophthalmus, and the second and third joints subequal in length, and together as long as the first joint; the flagella are broken off.

The second pair of antennæ has the flagellum also wanting; the scaphocerite is as long as the peduncle of the first pair, moderately broad, and armed with a small tooth at the outer distal extremity.

The mandible is furnished with a long and slender synaphipod that reaches beyond the frontal margins of the carapace and as far as half the length of the terminal joint of the second pair of antennæ.

The oral appendages, so far as I have been able to examine them without dissection, appear to correspond with those of *Sergestes prehensilis*.

The first pair of gnathopoda is well developed and of generic value only; the three anterior free joints are fringed on the posterior margin, and the three distal joints on the anterior margin, with long hairs.

The second pair of gnathopoda are broken off at the coxal joint, which is broad and robust.

The first pair of pereiopoda is moderately long, and furnished with a prehensile apparatus at the ultimate articulation. The second pair of pereiopoda is long and stout, probably as long as the animal, the distal joints being fringed with long hairs. The third pair of pereiopoda is similar to, but rather longer than the second. The fourth pair is very nearly as long as the third, reaching beyond the carpal joints of the propodos;

the dactylos is wanting. The posterior margin of the several joints are anteriorly smooth, posteriorly semiserrate, and fringed with very long delicately ciliated hairs. The fifth pair is broken off at the coxa.

The first two pairs of pleopoda are long and rather powerful organs; the first is single and smooth, as in females, and the second is two-branched.

Length of part preserved 18 mm., probable length of the entire animal 24 mm. (0·98 in.).

Sergestes ventridentatus, n. sp.

Carapace one-third the length of the animal not including telson nor rostrum. Rostrum short, sharp, horizontal, and armed with a small tooth on the dorsal surface anterior to the frontal margin.

Five anterior somites of the pleon subequal and dorsally smooth; three anterior ventrally produced in the median line to a plate that is armed with a strong and sharp tooth; the two posterior lobed and unarmed. Sixth somite equal in length to the two preceding combined, but narrower and produced to a point only at the posterior dorsal angle. Telson one-third the length of the sixth somite, anterior portion deep at the margins, posterior suddenly narrowed.

Ophthalmopoda rather more than half the length of the carapace, fungiform, stalk suddenly narrowed, ophthalmus broad.

First pair of antennæ having the first joint of the peduncle widened at the base to receive the otocyst, but not armed with a tooth on the outer margin. The three joints are subequal in length and the first two reach as far as the distal extremity of the ophthalmopod; the flagellum is slender and as long as the peduncle, the secondary appendage is merely a single-jointed, bud-like organ.

The second pair of antennæ has the scaphocerite long and narrow, reaching to the extremity of the peduncle of the first pair, and subapically armed with a small acute tooth. The terminal joint of the peduncle reaches to half the length of the ophthalmopod, but the flagellum is lost.

The first pair of gnathopoda appears to have the terminal joint shorter and more discoid than usual, and much narrower than the preceding joint.

The second pair is long and powerful, reaching considerably beyond the distal extremity of the flagellum of the first pair of antennæ; it has the four basal joints broad and stout, and the two terminal narrow and slender, the extremity being fringed with three fasciculi of hairs on the posterior and distal surfaces.

The first pair of pereiopoda is furnished with a small hook-like process on the anterior surface at the base of the ischium. The second pair of pereiopoda is not fully chelate, but only rudimentarily so; while the ischium is armed on the posterior margin

near the base with a strong sharp tooth. The third pair of pereiopoda is minutely chelate. The fourth and fifth pairs are rudimentary, the anterior being slightly jointed and the posterior in a state of gemmation.

The pleopoda are long and fairly robust, and have both branches far advanced in development. The posterior pair has the inner plate twice as long as the telson, and the outer three times as long, fringed on each side with hairs, those on the inner side long, on the outer short; it is not armed with a tooth at any point.

Length, 7 mm. (0·28 in.).

Habitat.—North of the Sandwich Islands.

Observations.—This species corresponds very closely with *Sergestes nasidentatus*, from which it differs in having the eyes much larger in diameter and more fungiform, but especially in having the median ventral surface of the three anterior somites produced to prominent lobes, surmounted by a strong tooth directed obliquely forwards. It differs also from *Sergestes spiniventralis*, which has the five anterior somites of the pleon similarly armed ventrally, but has every somite except the first dorsally furnished with a strong tooth, while in this species the dorsal surface is smooth throughout, excepting for a small point at the posterior extremity of the sixth somite, as in *Sergestes nasidentatus*, and it has the posterior pair of pleopoda smooth, whereas in *Sergestes nasidentatus* the outer margin is armed with a strong tooth. *Sergestes ventridentatus* was taken in Mid-Pacific, north of the Sandwich Islands, while *Sergestes spiniventralis* was found in the western part of the same ocean, and *Sergestes nasidentatus* was taken about 800 miles off the coast of Chili, at a depth of 200 fathoms.

Sergestes brachyorrhos, Kröyer.

Sergestes brachyorrhos, Kröyer, Monograph. Fremstilling af Kræb. Sergestes, pp. 56, 65, Tab. v. fig. 13, *a*, *b*.

"Rostrum distinctly prominent, very acute, and reaching to half the length of the ophthalmopoda. Ophthalmopoda very large, reaching to the extremity of the second joint of the peduncle of the first pair of antennæ, broadly clavate or subfungiform; ophthalmus very distinct from the peduncle, in breadth equalling half the length of the ophthalmopod, and in length scarcely a third of it.

"First pair of antennæ having the peduncle nearly one-fourth of the length of the animal, or more than two-thirds of that of the carapace. The first joint nearly equals the second and third combined, and is twice as long as the third.

"Second pair of antennæ having the scaphocerite more than four times longer than the last joint of the peduncle, and reaching to the extremity of the peduncle of the first pair of antennæ.

"Pleon having the fourth, fifth, and sixth somites armed with a small sharp tooth on the posterior margin of each. The first to the fifth somites also furnished with a sharp tooth on each side, especially distinguishable on the fourth and fifth.

"Sixth somite of the pleon exceeding the fifth part of the length of the animal, or equalling that of the third, fourth, and fifth somites combined, and three times as long as the telson, linear, and three times as long as broad.

"Pleopoda very slender.

"Rhipidura having no tooth on the outer margin of the outer branch.

"*Habitat*.—Greenland," (Kröyer).

I can recognise no form corresponding exactly with this species, but the next, *Sergestes utrinquedens*, differs from it in having a longer and more slender rostrum and a longer telson, and in having no teeth on the dorsal surface of the pleon.

Sergestes longirostris (p. 415, Pl. LXXV. fig. 3), differs from it in having a tooth on the outer plate of the rhipidura.

Sergestes utrinquedens, n. sp.

Carapace more than one-third the length of the animal not including the rostrum, which is straight, slender, and nearly as long as the ophthalmopoda. The frontal margin is rounded and smooth, but just beyond the fronto-lateral angle is a small anteriorly directed tooth. The rest of the carapace is free from ornamentation.

The pleon has the four anterior somites subequal, and all ventrally smooth and dorsally unarmed; the fifth is slightly longer than the preceding, and all these five somites have the lateral or coxal margins pointed and tipped with a strong sharp tooth, the first which is the largest has the smallest tooth, and the fourth which is the smallest has the largest tooth. The first somite is, moreover, furnished on each side with a small projecting process that corresponds to the pleocleis in other genera. The sixth somite is as long as the two preceding and is dorsally armed on the posterior margin with a small and slender tooth, and the postero-lateral angles are produced to a very minute point.

The telson is about as long as the last somite, and is produced into two sharp terminal points, flanked on each side with two small teeth or spines.

The ophthalmopoda are about half the length of the carapace; the ophthalmi broader than the stalk, which gradually tapers to the base.

The first pair of antennæ has the three joints of the peduncle subequal; the first joint is rather the longer, it is enlarged at the base to receive the otocyst, and is armed on the outer margin with a sharp tooth; the two succeeding joints are cylindrical and support flagella that are broken off.

The second pair of antennæ, which is broken at the extremity of the peduncle, has the basal joint armed on the outer and lower angle with a strong tooth, and carries a scaphocerite that is as long as the peduncle of the first pair of antennæ; it is narrow and has the margins parallel, the outer being armed with a long tooth near the distal extremity, and the inner fringed with long, slender, and distantly planted hairs.

The metastoma has no tooth at the anterior margin, but is produced to a blunt point.

The mandibles carry a strong two-jointed synaphipod.

The first pair of gnathopoda terminates in a long, ovate, spatuliform joint.

The second pair of gnathopoda is not remarkable for its length, and the terminal joint is only in an incipient stage of development.

The first pair of pereiopoda is wanting, being apparently broken off at the coxal joint. The second and third pairs are moderately long and terminate in incipient chelæ. The last two pairs are wanting and appear to be in an early stage of gemmation, and the two somites which support them are not appreciably distinct, and support on each side two small branchial plumes in an incipient stage of development.

The first pair of pleopoda is long, slender, and single-branched; the four succeeding pairs resemble the first, but carry a small secondary branch attached to the anterior angle of the distal extremity of the basal joint, which is more robust in the anterior and foliaceous in the following pairs, each successively increasing in length posteriorly.

The posterior or terminal pair is very long, being twice the length of the telson or quite equal to two-thirds of the length of the pleon. The plates are narrow and slightly curved; the outer is armed with a strong tooth near the middle of the margin, and is fringed with cilia on the inner and distal margins.

Length, 3·5 mm. (0·14 in.).

Habitat.—North Pacific Ocean.

Observations.—This species bears so close a resemblance to *Sergestes brachyorrhos*, Kröyer, that I was at first induced to believe it might be a younger form of that species, an opinion that received support from the form of the rhipidura and scaphocerite. It differs, however, from that species in the length of the telson, the shortness of which in Kröyer's species having probably suggested the specific name. The outer plates of the rhipidura are furnished with a strong tooth on the outer margin, and the narrow form of this appendage and of the scaphocerite is strong evidence of incomplete development. The absence of the fourth and fifth pairs of pereiopoda, or at least their presence only in a stage of incipient budding, is suggestive of this animal being the young of the genus *Acetes*—a genus that I have not had the opportunity of studying with care, as there does not appear to be a specimen of it in the extensive collection of the Challenger. But since Professor Brooks is inclined to believe that up to a certain

stage the posterior pair is wanting in most of the young of *Sergestes*, I prefer to reserve my opinion until I have had an opportunity of examining an adult form; I am the more inclined to do so on account of a specimen having been taken in the West Pacific, which, though evidently in a younger stage, corresponds with it in almost every important detail, having the posterior two pairs of pereiopoda more advanced in development, although still in a saccular condition. It is in the Mastigopus stage and is described at page 376.

Sergestes serrulatus, Kröyer.

Sergestes serrulatus, Kröyer, Monograph. Fremstilling af Kræb. Sergestes, pp. 52, 65, Tab. iv. fig. 12, *a–g*.

"Rostrum straight, rudimentary; furnished with three or four distinct teeth on the upper margin.

"Ophthalmopoda reaching to the extremity of the first joint of the peduncle of the first pair of antennæ, clavate, three times longer than broad.

"First pair of antennæ having the peduncle equal in length to the carapace, or even exceeding it, being a fourth of the length of the animal; first joint broad, deeply excavated, and furnished with a strongly pointed tooth.

"Second pair of antennæ having the scaphocerite narrow, sublinear, three times longer than the last thick joint of the peduncle, and nearly reaching to the distal extremity of the second joint of the first pair of antennæ.

"Sixth somite of the pleon nearly equalling the fifth part of the animal in length; twice as long as broad, equalling at least the length of the fourth and fifth somites combined, and exceeding that of the first and second together; nearly twice as long as the telson.

"Pleopoda moderate.

"Rhipidura armed with a tooth on the outer margin about one-third from the apex.

"*Habitat.*—Greenland" (Kröyer).

Sergestes caudatus, Kröyer.

Sergestes caudatus, Kröyer, Monograph. Fremstilling af Kræb. Sergestes, pp. 54, 68, Tab. v. fig. 14, *a–d*.

"Rostrum large, equalling one-fourth (?) part of the carapace in length, and furnished on the upper surface with six or seven small teeth.

"Ophthalmopoda very short, stoutly pyriform, scarcely reaching to the extremity of the first joint of the peduncle of the first pair of antennæ, having the ophthalmus slightly distinct from the pedicle, and nearly half the length of the ophthalmopod.

"First pair of antennæ having the peduncle about two-thirds the length of the carapace, and equal to a fifth part of the entire length of the animal. First joint very long, longer than the second and third combined; third very short.

" Second pair of antennæ having the scaphocerite linear, reaching a little beyond the extremity of the peduncle of the first pair of antennæ, eight times as long as broad, and nearly nine times longer than the last joint of the peduncle.

" Sixth somite of the pleon considerably elongated, sublinear, exceeding one-fifth of the entire length of the animal, longer than the three preceding somites together, and three times as long as broad.

" Pleopoda very slender.

" Telson but little shorter than the outer plates of the rhipidura, the outer margin of which is furnished with a sharp tooth, situated not far from the distal extremity.

" *Habitat.*—Greenland" (Kröyer).

Sergestes arcticus, Kröyer.

Sergestes arcticus, Kröyer, Monograph. Fremstilling af Kræb. Sergestes, pp. 24, 60, Tab. iii. fig. 7, *a–g*; Tab. v. fig. 16.

" Rostrum rudimentary.

" Ophthalmopoda pyriform, much shorter than the first joint of the peduncle of the first pair of antennæ; ophthalmus very distinct from the pedicle, broader than long, the diameter being equal to half the length of the ophthalmopod.

" The peduncle of the first pair of antennæ about one-third shorter than the carapace. The second and third joints nearly equal in length, and together but little longer than the first.

" The last joint of the peduncle of the second pair of antennæ three times as long as broad, and about the third of the length of the scaphocerite.

" Sixth somite of the pleon about the fifth part of the length of the animal, and equalling that of the first, second, and third somites combined, but surpassing in length that of the fourth and fifth somites combined; twice as long as broad, and nearly twice as long as the telson.

" Pleopoda long and slender; the basal joint of the fifth pair twice as long as broad.

" The outer branch of the rhipidura armed with a tooth on the outer margin, one-third from the terminal apex.

" *Habitat.*—Greenland" (Kröyer).

Sergestes obesus, Kröyer.

Sergestes obesus, Kröyer, Monograph. Fremstilling af Kræb. Sergestes, pp. 41, 62, Tab. iv. fig. 10, *a–f*.

" Rostrum upright, rudimentary.

" Ophthalmopoda pyriform, scarcely reaching to the extremity of the peduncle of the first pair of antennæ, but quite to the extremity of the second.

"The ophthalmus not very distinct from the pedicle, the breadth scarcely equalling half the length of the ophthalmopod, but certainly more than a third.

"The first pair of antennæ has the peduncle scarcely half the length of the carapace; the first joint subclavate and distinctly longer than the second and third.

"The second pair of antennæ having the last joint of the peduncle very short, robust, subquadrate, nearly equalling in length one-fifth of the sublinear scaphocerite.

"Sixth somite of the pleon scarcely longer than broad, and in length nearly one-seventh of the animal; shorter than the fourth and fifth somites united, and also than the united lengths of the first and second; nearly a third longer than the telson.

"Pleopoda very short and stout.

"Rhipidura having the outer branch armed on the external margin near the extremity with a small point.

"*Habitat.*—Greenland" (Kröyer).

Sergestes dissimilis, n. sp.

Animal slender. Carapace about one-third the length of the entire animal. Rostrum slender, armed on the dorsal crest, slightly posterior to the frontal margin, with a small tooth, and on the gastric region with a small dorsal cusp.

Pleon having the five anterior somites subequal in length, the sixth being longer than the preceding two united. The anterior three are dorsally smooth, the posterior three being furnished with a small tooth at the posterior margin.

Telson long and tapering, not reaching quite as far as the extremity of the inner plates of the rhipidura, but nearly equal with the lateral tooth on the margin of the outer plate, terminating in two strong teeth, and laterally furnished with two small spines on each side.

The ophthalmopoda are about one-third the length of the carapace, and reach a little beyond the distal extremity of the first joint of the peduncle of the first pair of antennæ; they are clavate, gradually increasing in size from the base to the extremity, where the ophthalmus is of greater but not of suddenly increased diameter.

The first pair of antennæ has the first joint subequal in length to the ophthalmopoda, and the two succeeding joints are subequal in length to each other, and together about as long as the first. The flagella are broken, but judging from the portions left, the smaller is longer than usual.

The second pair of antennæ carries a narrow scaphocerite that reaches beyond the distal extremity of the second joint of the first pair of antennæ, and terminates in a rounded extremity, armed on the outer margin with a strong tooth.

The gnathopoda and pereiopoda offer no very decided features of specific variation. The second pair of gnathopoda is wanting, and the first pair of pereiopoda is broken off

at the meros. The second pair is long and slender, fringed with long hairs, and terminates in a small but well-formed chela. The third pair is wanting, being broken off at the basis. The fourth pair is broken off at the middle of the carpos, but, judging from the portion left, it is a longer appendage than usual; the fifth pair is short, cylindrical, and saccular, and within the sac three articulating divisions are apparent.

The pleopoda are long and slender, the first pair being single-branched, the others unequally biramose, and becoming slightly more robust posteriorly. Those of the sixth pair help to form the rhipidura, and are longer than the telson, the outer branch being furnished with a tooth that is one-third distant from the distal extremity.

Length, 10 mm. (0·4 in.).

Habitat.—April 26, 1876; St. Vincent, Cape Verde Islands; at the surface.

Observations.—This species differs from *Sergestes nasidentatus* in having the small tooth on the dorsal crest a little posterior to the frontal margin, a cusp on the gastric region, and a small tooth at the posterior dorsal extremity of each of the three posterior somites of the pleon.[1]

Sciacaris,[2] n. gen.

Like *Sergestes*, but having the telson terminating in two lateral uniarticulate appendages.

This genus, if genus it be, is founded on three specimens in three different stages. The youngest is in the Acanthosoma stage, the second in the Mastigopus condition, and the third in that of the young adult. They appear to be different stages of two species, and as such I shall describe them.

The several specimens were taken off New Guinea, and in the North Pacific Ocean.

Sciacaris telsonis, n. sp. (Pl. LXXVIII. fig. 1).

Carapace nearly half the length of the animal, not including the rostrum or telson. Rostrum long, slender, and nearly half the length of the carapace. Frontal margin armed with a slender tooth on the outer side of the first pair of antennæ. Dorsal surface and lateral margins smooth.

Pleon having the first five somites subequal, and the sixth about as long as the three preceding united.

Telson (fig. 1z) about half the length of the sixth somite, bifurcate at the extremity, each process supporting a small articulating joint of considerable tenuity, armed at the apex and outer margin with one or two articulated spines.

The ophthalmopoda are clavigerous and about as long as the rostrum.

[1] Since the foregoing was in type I have discovered that the genus *Podopsis*, established in 1829 by Vaughan Thomson, is synonymous with *Sergestes*. But as the former name was used in 1819 for a genus of Mollusca by Lamarck, Milne-Edwards' appellation must stand.

[2] From σκιά, shadow, and καρίς, shrimp.

The first pair of antennæ has the peduncle rather longer than the rostrum, having the first joint long and the two following short, terminating in two flagella, of which the inner is short and uniarticulate, and the outer stout, but in the specimen it is broken at the first articulus. The base of the first joint of the peduncle is broad and flat, furnished on the outer margin with a strongly projecting point; within this space is an otocyst containing a spherical otolith.

The second pair of antennæ is broken off at the extremity of the peduncle, which is short, stout, and carries a scaphocerite that is long, narrow at the base, and increasing in width towards the extremity, armed with a tooth on the outer side and foliaceous on the inner, which is furnished with cilia.

The mandibles are not furnished with a synaphipod.

The first pair of gnathopoda is like that of *Sergestes*, but the terminal joint is rather cylindrical than spatuliform, but this may be the result of its immature condition.

The other appendages of the pereion are broken off, so that I cannot determine their form, nor can I determine the presence of the last two pairs of pereiopoda. The first somite of the pleon is furnished on each side with a projecting process that is homologous to the pleocleis of larger species.

The pleopoda are all long and single-branched, all but the first pair having a small bud-like process, which is the rudiment of the inner ramus, at the distal extremity of the basal joint; these are small on the second pair, and gradually increase in size posteriorly. The sixth or terminal pair, which forms the outer plates of the rhipidura, has the basal joint armed on the outer distal angle with a short robust tooth. The outer plate is a little longer than the telson, and is armed on the outer margin with a long tooth about one-third distant from the apical extremity; the inner branch is narrow and tapering, about the length of the telson, and fringed on both sides with long delicate hairs.

Length, 4 mm. (0·17 in.).

Habitat.—North of New Guinea.

Observations.—The absence of the posterior two pairs of pereiopoda is suggestive of its relation to the genus *Acetes;* but the specimen is undoubtedly that of an animal not fully grown. The ocellus is still visible as a small longitudinal black streak. The rostrum is slender, and has a deciduous appearance from its delicate, thin, dermal covering. This is also the condition of the terminal appendages of the telson, and the general structure is that of an animal that has not arrived at its mature condition, but is approaching it, although its dimensions are still small.

The second stage represented on Pl. LXXVIII. fig. 2, is in the Mastigopus condition, and is more perfectly preserved than the preceding.

The carapace is nearly as long as the pleon, excluding the telson. Rostrum broken. Dorsal surface armed with a tooth on each side corresponding with the extremity of the

apophysis of the mandible; the rest of the carapace is smooth both at the margin and on the dorsal surface.

Pleon having the anterior five somites subequal; the first and second are dorsally armed with a small tooth, anteriorly to the posterior margin, so also are the third, fourth and fifth somites, but on these each tooth is twice as long, and nearer to the posterior margin. Fifth somite with a small tooth above the inferò-posterior angle. Sixth somite as long as the four preceding combined, and armed at the posterior dorsal margin with a slender tooth.

The ophthalmopoda are long and clavigerous.

The first pair of antennæ has the peduncle rather longer than the ophthalmopoda, and has the first joint long and the two following short, of which the third is shorter than the second, and terminates in one long and robust flagellum (broken), and one short and uniarticulate; the base of the first joint is enlarged, armed with a tooth on the outer margin, and contains an otolith.

The second pair of antennæ has the flagellum broken off at the extremity of the peduncle, which carries a long, narrow scaphocerite, armed on the outer margin with a long tooth (2*c*) that commences at some distance from the extremity and passes beyond it.

The appendages are all in an immature condition, but the second and third pairs of pereiopoda exhibit signs of an incipient chelate character. The fourth and fifth pairs are present in a budding condition; the fourth is larger than the fifth.

The pleopoda are long, slender and single-branched, having the bud of the second branch present on the last two pairs only.

Terminal or lateral branch of the rhipidura long and narrow; the outer longer than the telson, and furnished with a tooth near the middle of the outer margin, beyond which it is fringed with long hairs as is also the inner plate.

Length, 4 mm. (0·17 in.).

Habitat.—North of New Guinea.

Observations.—This specimen was taken associated with the preceding, to which it bears considerable resemblance, but differs from it in several details which I believe to be dependent upon development.

The dorsal teeth on the pleon and that on the lateral margin of the fifth somite probably disappear with growth; the form of the scaphocerite becomes broader and the subapical tooth smaller, the rostrum shorter, and the terminal appendages of the telson probably disappear in the adult animal. But the two last pairs of pereiopoda, which are now in a budding condition, probably become developed into rudimentary or imperfect appendages, as seen in *Sergestes;* and the lateral dorsal teeth on the hepatic region of the carapace probably continue as a more or less important feature, and therefore suggest that this specimen when mature is specifically distinct from the preceding.

The next, which is the youngest known stage (Pl. LXXVIII. fig. 3), is in the Acanthosoma condition, and as such approaches others in its generic value.

The carapace is short, or about half the length of the pleon, exclusive of the telson.

The rostrum is long, slender, and fringed with teeth; the lateral margin of the carapace corresponding with the antero-lateral angle is armed with a tooth of extreme tenuity and fringed with small spines.

Pleon armed with ornate spines or teeth on the lateral margins, and dorsally on the posterior four somites.

Telson (fig. 3z) bifurcate and terminating in two uniarticulate appendages, tipped with one or two small hairs.

The ophthalmopoda are large, broad, and fungiform.

The first pair of antennæ has a three-jointed peduncle, of which the first joint is long and the two succeeding short, supporting two flagella, one short and uniarticulate, the other scarcely half the length of the peduncle and biarticulate. The basal extremity of the first joint is not enlarged to receive an otolith.

Second pair of antennæ carries a flagellum that reaches but little beyond the ophthalmopod, and a scaphocerite that nearly equals it in length, and which is furnished on the outer margin, near the extremity, with a long tooth fringed with marginal teeth (not properly represented in the figure).

There are seven pairs of appendages that represent the gnathopoda and five pairs of pereiopoda, of which the last two are feeble and the others tolerably robust.

The pleopoda are all single-branched, and exhibit no signs of an inner ramus, except the posterior pair, which goes to form the rhipidura. The plates of this pair are long, narrow, and reach beyond the extremity of the telson; the outer is armed with a strong tooth one-third distant from the extremity.

Length, 3 mm. (0·12 in.).

Habitat.—North Pacific Ocean.

Observations.—This is a younger form and may develop into either *Sergestes* or *Acetes*, as it possesses no feature that might not become modified in the course of its progressive growth.

Acetes, Milne-Edwards.

Acetes, Milne-Edwards, Ann. d. Sci. Nat., t. xix. p. 350, 1830.
„ „ Hist. Nat. des Crust., t. ii. p. 429.

There is no specimen in the extensive collection of species of this family that I can recognise as belonging to this genus.

Professor Brooks[1] figures a specimen as a young *Acetes*, $\frac{80}{1000}$th of an inch long

[1] *Phil. Trans.*, pl. x. fig. 85, 1882.

(2 mm.), and also figures[1] an older specimen, $\frac{15}{100}$th of an inch (4 mm.) long, in which, besides the characteristic absence of the posterior two pairs of pereiopoda, the anterior three pairs, unlike *Sergestes*, resemble those of *Penæus* in all three being chelate.

On Pl. LXVII. of this Report, fig. 4 represents an animal 7 mm. long (described as *Mastigopus spiniventralis*, at page 379), that is almost identical in form with that given by Brooks in his fig. 85 above referred to, excepting that neither pair of pereiopoda possesses any trace of a chelate character. Believing this to be a young *Sergestes* in the Mastigopus stage, I have named it so accordingly, assuming, that as in every specimen analytically examined I found the posterior pair of pereiopoda in a budding condition, but more or less developed, that they were present in this also, although it corresponded closely with Milne-Edwards' description of the genus *Acetes* in having the pereiopoda filiform and terminated by a single point (sont filiformes et terminées par un article pointu).[2] To see it figured with three pairs of chelate appendages similar to *Penæus*, as shown by Professor Brooks in his plates, and confirmed by his description, suggests that the specimens examined were not the young of *Acetes*.

I am aware that Professor Milne-Edwards originally described *Sergestes* as having the pereiopoda filiform and monodactyle, and that we are indebted to Professor Kröyer for first pointing out that two pairs of these appendages terminated in minute chelæ, but Kröyer did not make this character a feature of the genus as has been done in this Report, inasmuch as several of the species that he has described in his Monograph on this genus have the pereiopoda terminating in a monodactyle extremity, a condition which, throughout this Report, I have attributed to the immature stage of Mastigopus.

So far as my knowledge goes the genus *Acetes* has never been fully described or noticed at all from independent observation, since it was first published by Professor Milne-Edwards nearly sixty years ago, nor am I aware of any specimens having been observed, excepting those from which Milne-Edwards drew his description, and which are still preserved in the Museum of the Jardin des Plantes at Paris. These type specimens are recorded as inhabiting the Ganges, in which river, or in the sea near its mouth, they must be very abundant, for among the specimens of Crustacea collected by Sir Walter Elliot, S. I., there were several specimens of *Acetes indicus* (Pl. LXXXV. fig. 1), and with them was a note stating that they were taken in 1852 from a large fish "21 feet in length and 25 broad" (*Dicerobates eroogoodoo*); its stomach was filled with myriads of these little Crustaceans, which were carried away in bucketfuls by the fishermen, and thousands were left scattered about the shore.

Milne-Edwards says this genus ought to be placed very near the Schizopoda.

[1] *Loc. cit.*, pl. xi. fig. 90.
[2] *Ann. d. Sci. Nat.*, t. xix. p. 350, 1830.

Subfamily Luciferinæ.

This subfamily is formed to receive those Sergestidæ that have no branchiæ attached to the pereion; in which the two anterior pairs of pereiopoda are not chelate, and the third pair has the chelæ reduced to a more or less imperfect condition; in which the ova are carried beneath the pereion, but appear not to have any special means of attachment, and in which the brephalos is hatched in the Nauplius form. Of this subfamily there is known to exist only a single genus.

Lucifer, Vaughan Thompson.

Lucifer, Vaughan Thompson, Zool. Researches, p. 58, pl. vii. fig. 2, 1829.
Leucifer, Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 469.
Lucifer, Dana U.S. Explor. Exped., Crust., p. 668.

Animal long, slender, and laterally compressed. Cephalon cylindrical, and produced to a great length anteriorly to the mandibles, so that the antennæ and ophthalmopoda are removed considerably from the oral and other appendages. The pereion is short and dorsally covered with a small receding carapace. The pleon is very long, being about two-thirds the length of the animal, and has the five anterior somites subequal, whereas the sixth is about twice or thrice the length of either of the preceding.

The telson is narrow, compressed and tapering, differing more in sexual than in specific form.

The ophthalmopoda are long, narrow, and terminate in round, bulbous ophthalmi.

The first pair of antennæ (Pl. LXXIX., *b*) has a three-jointed peduncle and a single slender flagellum, and carries within the basal portion of the first joint a well-defined acoustic organ (or otolith).

The second pair (*c*) has the joints of the peduncle closely united; the first supports a long, slender phymacerite, and the second a long, slender, somewhat styliform scaphocerite; and the terminal joint is long, robust, and supports a long, slender flagellum.

The distance from the second pair of antennæ to the epistoma is greater than from that to the posterior extremity of the pereion, and these together form about one-third the length of the animal.

The mandibles do not carry any synaphipod, and have the margin of the psalisiform blades serrate.

The first pair of siagnopoda (*e*) is three-lobed, two lobes being on the inner side, one of which is broad and fringed with several strong spines, the other narrow and furnished with a few slender spines or hairs; and one on the distal surface that is narrow, cylindrical, and free from ornamentation.

The second pair (*f*) consists of four foliaceous lobes; the two basal are produced inwards,

and each is crowned with four strong spinous teeth, or spines; the third is broad, of great tenuity, and fringed on the inner margin with a row of closely planted, simple, stiff hairs or smooth spines; the fourth lobe is posteriorly attached to the base of the preceding, and is produced anteriorly and fringed with seven or eight long, ciliated hairs; it is also produced considerably posteriorly, and fringed at the extremity with five long, ciliated hairs, the margins between the two extremities being naked and free from hairs or cilia. This plate is the homologue of the mastigobranchia, which Dana calls the "fouet," and which he has observed playing with constant motion beneath the carapace in the living animal.

The third pair of siagnopoda (*g*), or first maxillipedes, is only two-jointed; the basal joint is broad, foliaceous, and fringed on the inner margin with long, robust, simple hairs; the second is narrower, of similar construction, and furnished with a double row of similar hairs; these appendages are short but larger than the preceding, and generally lie like an operculum protecting the organs of the mouth, which are protruded and much exposed.

The first pair of gnathopoda (*h*) is tolerably robust and six-jointed; the basis and ischium forming a curve, articulate with the meros at a right angle, which causes the three succeeding joints to be directed posteriorly; all the joints bear strong ciliated hairs, and the terminal joint ends in a blunt round extremity.

The second pair of gnathopoda (*i*) is more slender, and corresponds in length with the first; it is only five-jointed, and terminates in an obtuse point.

The first pair of pereiopoda (*k*) is shorter than the gnathopoda, but much resembles the second pair in its feebleness of character. The second pair of pereiopoda (*l*) is very much longer than the first and much more robust. It is six-jointed, and terminates in an obtuse extremity sparsely ciliated with fine hairs. The third pair (*m*) resembles the second in size and general aspect, but terminates in a minute dactylos that gives to the extremity when magnified the appearance of being chelate and furnished with long hairs. The fourth and fifth pairs of pereiopoda are not developed.

The first pair of pleopoda is attached near the middle of the ventral surface of the first somite of the pleon, and has a long basal joint and terminates in a single branch. The four succeeding pairs gradually shorten posteriorly and support two rami each; those of the sixth pair differ from the others and form the lateral plates of the rhipidura. The basal joint is short and the outer plate long and terminates subapically in a sharp tooth, whereas the inner plate is shorter, more tapering and slender than the outer, and fringed with cilia on both margins.

Organs of Generation.—The reproductive organs of the male animal were first figured by Vaughan Thompson[1] and again by Dana,[2] but without either of them having a full appreciation of the character and importance of their observations; a circumstance that probably accounts for their not having been noticed by other writers.

In 1861 Dr. Semper described, without any illustration, the form of these structures,

[1] *Loc. cit.*, pl. vii. fig. 2.

[2] U.S. Explor. Exped., Crust., Atlas, pl. xliv. fig. 9*h*.

both in the male and female, from specimens procured at Samboangan, one of the Philippine Islands, and in 1872 he gave a second memoir with illustrations on the same subject. In these he stated that the vas deferens has but one opening, and that in the median line on the ventral surface. This was confirmed by Anton Dohrn in 1871, who also demonstrated that the form of the adult animal corresponds with that of Vaughan Thompson's figure.[1]

The fact of there being a single opening of the vas deferens, and that in the median line, is contested by Professor Brooks in his memoir on *Lucifer*,[2] where he asserts[3] it has "two external openings; they are not on the median line, and their position in the body does not correspond to that of the female orifice; but in other respects my own observations show the correctness of" Semper's "description."

Professor Brooks appears to have had "an abundant supply of adult specimens of both sexes," and was consequently enabled to give a more complete account of the structure and relations of the reproductive organs. He says[4]:—"The body of the animal is so thin (narrow) that it is almost impossible to get a good dorsal view without crushing the specimen; but a very careful examination of the side view seems to show that there is only a single organ on the median line of the body, as Semper states. On each side of the intestine, along the line where the testis joins its wall, a small tubular vas deferens arises, and runs backwards along the side of the intestine nearly to the end of the first abdominal" (pleonic) "somite, to which it seems to be attached by a ligament. It then bends outwards and forwards upon itself to form a second much larger portion, which is parallel to and outside of the first portion, and reaches nearly to the anterior edge of the first abdominal somite. The third or terminal portion has a large cavity, thick walls, and it runs down to an external opening which is situated on the outer edge of the sternal surface of the thoracic" (perionic) "region, behind the basal joint of the third pereiopod, and therefore in the position which would be occupied by the basal joints of the fourth or fifth pereiopods if they were present.

"There is a vas deferens, made up of these three portions, on each side of the body, and the ventral nerve-chain passes between their external openings.

"The more anterior follicles of the testis are almost perfectly transparent, but the development of the male cells in the posterior ones gives to them a faint granulation. The first division of the vas deferens has a small cavity, thin walls, and as it usually seems to be entirely empty it is probable that the passage of the male cells from the testis through it to the second division takes place quickly. The second division has a very large cavity, and in it the male cells become arranged in a single layer around the surface of a central core, which is formed of some dense transparent adhesive substance.

"The spermatophore appears to pass into the third chamber before it is completely

[1] Zoological Researches, 1829.
[2] *Phil. Trans.*, p. 57, 1882.
[3] *Loc. cit.*, p. 58.
[4] *Loc. cit.*, p. 59, *et seq.*

formed, as all those which were seen in the second chamber consisted only of a central core and a layer of male cells, while those which were contained in the thick-walled third chamber had an outer enveloping capsule.

"I have found several specimens with a fully-developed spermatophore on one side of the body and none on the other side, and was thus enabled to thoroughly satisfy myself of the presence of two vasa deferentia, and two external openings.

"I was unable to discover how the spermatophore is transported to the body of the female, or what part the clasping organ upon the first pleopod of the male performs during the act of copulation.

"Upon several occcasions I observed a male clinging to the basal joints of the first antennæ of a female, but as I never succeeded in getting the pair under a lens without separating them, I made no careful examination. Copulation usually takes place during the daytime, or at least this was the case in every instance which I observed. In several cases I found female specimens with a simple fresh spermatophore attached to the opening of the seminal receptacle. This opening is situated between and a little anterior to the basal joints of the third pair of thoracic limbs. As the spermatophore gradually discharged its contents, it was easy to see that both the central core and the investing layer of spermatozoa escaped from the outer sheath and passed into the seminal receptacle. In all the breeding females which I have observed the spermatozoa filled the posterior, and the transparent core of the spermatophore the anterior half of the spermatic receptacle. The ovary is very long, and it lies under the intestine, reaching from the fifth abdominal (pleonic) somite to the posterior edge of the carapace, where it bends upon itself at right angles and runs down to its external opening, which is upon or close to the median line of the ventral surface, a little in front of the third pair of pereiopods. The wall of the ovary is so very thin and delicate that I was not able to detect it at all except when it is filled with ripe ova. These are very much elongated, granular, and slightly opaque; and there does not seem to be any shell around them. They are very elastic, and undergo great changes of shape as they pass through the small oviduct.

"Oviposition occurs between 9 and 10 o'clock in the evening, and occupies only a few minutes.

"After the eggs are laid they are spherical, transparent, and each one has a rather thick shell. They are attached, in a loose bunch of twenty or more, to the last pair of thoracic limbs, and in order to save space I have shown them in fig. 74, although the specimen from which the figure was drawn had not laid any of its eggs.

"As I obtained very few ripe females, I was not able to sacrifice one of them to study the reproductive organs under pressure, and I am therefore unable to decide whether any parts of this system are double; but I feel confident that there is only one spermatic receptacle, and the opening of the oviduct seems to be upon the median line." I have been induced to quote Professor Brooks' memoir on this subject very fully because of its

variance from the observations of preceding writers, and the greater advantages at his disposal in the quantity of living specimens at his command.

Those in the Challenger collection, although numerous and obtained from all parts of the Atlantic and Pacific Oceans within tropical and subtropical regions, are few in comparison, especially those in which the reproductive parts in either sex are in a condition for analytical examination, and these from their long retention in an alcoholic fluid, are less transparent than those that were at the command of Professor Brooks.

In our male specimens the testes are numerous and suspended in bunches from a continuous cord apparently traversing the median line immediately beneath the alimentary canal, extending anteriorly as far as the second pair of gnathopoda, and posteriorly to the first somite of the pleon, where it appears to me to be connected with a large chamber that extends posteriorly in the form of a gradually narrowing and pointed *cul de sac*, in which the spermatophores are developed, and from the anterior extremity of this cavity an opening on each side anteriorly passes into a vas deferens that descends almost vertically, or at most but slightly forwards to the posterior ventral extremity of the pereion, one on each side of the neural cord that traverses the ventral surface of the pereion. It is probable that in the same animal only one duct is in use, inasmuch as two spermatophores are never equally developed at one time or proceed simultaneously, and when they succeed each other with rapidity, they, according to the figures given by Dana and Professor Brooks, traverse the same channel in succession. Undoubtedly in the specimens that I have studied, the vas deferens sometimes passes down on the left side, as shown on Pl. LXXX. fig. 1, while in another specimen it is on the right side; in the latter the vas deferens appears to be empty, as if a spermatophore had recently been extruded, while the nuclei of three others appear to be in a state of formation. In the former specimen a spermatophore appears to be approaching the period of extrusion, and another in an earlier condition within the chamber.

The spermatophore when ready to be discharged is quite equal to, and in some instances longer than, half the depth of the animal, the large end in advance, the sharp or pointed extremity following; when the stouter end reaches the external extremity of the passage through which it travels, it presses against a thin membrane that appears to close the orifice of the vas deferens and retain the spermatophore in position until circumstances require its extrusion; it is then in all likelihood caught by the petasma, where it is retained until it is required for the impregnation of the ovum.

That the petasma is capable of so holding it may, I think, be accepted from an examination of its structure, which I have illustrated on Pl. LXXX., *ptm*, showing it in lateral aspect, with the anterior central portion, which is considerably advanced, detached and more highly magnified to show the inner surface corrugated in the median line as if it were formed for grasping and holding the spermatophore, which it probably does, by the latter being dropped with the thick end into the grasping process of the petasma, the

pointed and narrow extremity falling forwards ready for insertion when the opportunity occurs.

The second pair of pleopoda carries, attached to the base of the inner of the two rami, a rigid branch that is about a third of the length of the one to which it is attached. The object of this, which is only present in male animals, is not very obvious, and it is only a conjecture, when I say that it may be useful in adding power to retain the preceding pair in position during copulation.

When the spermatophore is liberated from the influence of the male animal, the smaller extremity is inserted into the oviduct and there retained, the ova being fertilised as they pass through the seminal receptacle, which opens on the inner side of the third pair of pereiopoda (Pl. LXXXI. figs. 1♀, 2♀).

This latter organ I have not been able in the specimens at my command to determine to be of the inverted bottle-shaped form as figured by Professor Brooks; nor does it appear to open anterior to the third pair of pereipoda, but according to my observation it is only a slight enlargement with a constriction, or rather a series of constrictions, that forms a series of chambers in the oviduct.

Professor Brooks says that there is only one opening, and his opportunity and power of observation are so great that they demand assent, but I can only state, according to the opportunities of my own observation, that the neural cord, which consists of an elongated mass with bulbs increasing in size from the oral appendages to the third pair of pereiopoda, whence it continues as a fine thread until it reaches the first pair of pleopoda, passes behind or rather on one side of the ovisac, and therefore the neural cord being in the median line the ovisac must be on one side; that on the opposite side, as in the males, is probably obsolete or only periodically in use.

The ovaries are very long, and in some specimens reach as far back as nearly to the middle of the sixth somite of the pleon (fig. 1♀), where they terminate in a gradually narrowing point; the posterior portion is full of simple granules, and the anterior with gradually ripening ova.

Observations.—So far as I can determine, there are only two species of *Lucifer*, and these are probably the same as recorded by Milne-Edwards in his short description. All other forms, of which I give several figures, are, I believe, only dependent upon variation in the progress of development. Even the two recognised species differ but little in important characters. The ophthalmopoda of one are longer than those of the other, and the form of the teeth on the lateral margins of the sixth somite of the pleon in the males varies but little. The other external features of difference are not very considerable. The last mentioned difference only exists in the male animals, whereas the females closely resemble one another in both species, except in the relative length of the ophthalmopoda.

Dana, in his Report on the Crustacea of the U.S. Exploring Expedition, describes

three new species, but from comparison with those I have figured I am convinced that they are only immature forms of the already known species.

Professor Brooks[1] says:—"We found a few adult specimens out at sea, but, while I was able to learn little about their habits, I think that they are not strictly pelagic, but that their proper home is the salt marshes close to the ocean.

"They were met with in the greatest abundance about half a mile inside Old Topsail Inlet, near a large marsh, during the first hour of the ebb tide, on calm evenings when the tide turned between 7 and 8 P.M.; and I infer that they leave the marshes at this time to breed in the ocean. All the mature females which we found, with one exception, were captured under these peculiar conditions; and we never failed to find them at this spot when the tide turned about sunset and the water was calm."

Development of Lucifer.

The interest in the study of this genus has been maintained ever since its first discovery was made by Vaughan Thompson. This has been largely owing to the anomalous appearance of the animal, arising chiefly from the enormous longitudinal development of the regions between the anterior lip and the second pair of antennæ; the reduction of the pereiopoda to three pairs, and the greater comparative development of the pleon and its appendages, herein exhibiting features the very opposite to those of the aberrant Amphipoda, where the pereion is increased in proportion and the pleon reduced to a rudimentary condition.

The difficulty of studying the history of the animal has been increased by the fact that the female does not carry the ova attached to the pleopoda, as among the Prawns, or in an ovisac as in other Crustacea. No one before Professor W. K. Brooks,[2] so far as I am aware, ever observed the female bearing ova at all, and he found them in the anomalous condition of being attached to the posterior pair of pereiopoda instead of to the pleopods, and they appear to be retained in position by some adhesive property of the ovum instead of being linked together like a bunch of grapes by a tissue developed for the purpose. According to Professor Brooks the deposition of the ova takes place between nine and ten in the evening and occupies only a few minutes. After deposition, they are spherical, transparent, and have rather a thick case, and are loosely attached in a bunch of about twenty to the third or posterior existing pair of pereiopoda, and so feeble is their attachment, that "even when great numbers of mature specimens are captured in the breeding season, with the greatest care and delicacy, very few of them, much less than one per cent., are found to have eggs attached to their limbs." About thirty hours after oviposition, the ocellus and appendages of the embryo become visible inside the outer envelope, and after thirty-six hours the brephalos is hatched in the

[1] *Loc. cit.*, p. 60.

[2] *Loc. cit.*, p. 64.

form of a Nauplius, $\frac{8}{1000}$ of an inch in length, and, according to Professor Brooks' figure, nearly as much in its broadest diameter. The brephalos is ovate in form and carries three pairs of free appendages, of which the anterior is single-branched and the two succeeding biramose. The anterior labrum is large and prominent; posterior to it is a double row of four pairs of bud-like eminences, arranged in longitudinal series. The three free appendages have hairs projecting from their extremities, which lengthen considerably within a few minutes after the embryo is extruded from the egg. These three appendages are organs of locomotion, and by their agency the animal is propelled through the water. The motions of the brephalos are very erratic and violent, and consist of a series of quick leaps produced by vigorous strokes of the appendages, much like those of a young Copepod or Cirriped.[1]

The outline of the body (Professor Brooks says) is pear-shaped, with the broad end at the posterior extremity, when the second maxillæ are in the centre of the field of view; but when the metastoma is in the centre this is reversed, and the broad end is in front. This difference is due to the fact that the dorsal region is much wider than the labrum and to the series of buds, which together form a ridge along the ventral surface.

The dorsal portion of the posterior region of the body is swollen and rounded, and near its lateral margins there is a pair of small but very conspicuous dark pigment-spots, which might easily be taken at this stage for ocelli, since they are nearly of the same size and colour. These two pigment-spots are very conspicuous during all the early stages of the metamorphosis, and their position during the later stages shows that the portion of the Nauplius body which bears them becomes the pereion and not the pleon in the maturer form.

When the brephalos is just hatched it is, as in this stage of all these animals, enclosed within a delicate cuticle, which, however, is soon torn off, probably through the forcible extension of the hairs of the appendages. In this early stage Professor Brooks had no difficulty in keeping it alive, and was thus enabled to contribute largely to our knowledge of the life history and morphology of this curious and interesting little creature.

In about twelve or fourteen hours the Nauplius sheds its skin, and increases in length from $\frac{8}{1000}$ (0·2 mm.) to $\frac{9}{1000}$ (0·225 mm.) of an inch, and the extremity of the pleon is posteriorly projected, showing the telson in a forked condition, and furnished with two pairs of short stout spines, the inner pair being longer than the outer. A well-marked fold of the surface of the body now distinguishes the posterior and lateral margins of the carapace, but this line is not continued on to the anterior end of the body, and the posterior edge is not yet raised or separated from the hind body as it is, according to Metschnickoff, in the Nauplius stage of *Euphausia*.

The two small pigment-spots that were noticed in the earlier stage are in this drawn out in such a way as to surround a large rectangular area at the posterior end of the carapace, and in the region where the heart becomes visible in the next stage.

[1] *Loc cit.*, p. 73 *et seq.*

The digestive tract has become visible; the œsophagus, which commences immediately behind the labrum, rising upwards and backwards to open into the floor of the stomach. The intestine is small, with thin walls, and it follows the dorsal curvature of the body to the anus, which is placed just in front of the spines of the telson.

The nervous system is present in the form of a cerebral ganglion and a neural mass that is obscurely divided into segments, which passes beneath the stomach.

Within twelve hours the animal moults, and increases from $\frac{9}{1000}$ (0·225 mm.) to $\frac{20}{1000}$ (0·5 mm.) of an inch, or to rather more than twice its length, and changes its form from that of a Nauplius to that of a Zoea—a change chiefly due to the development of the carapace and the great increase in the length of the pleon.

The great increase in size, more than twice, and the remarkable variation in form are such, that nothing less than the exactitude shown in the observations made by Professor Brooks would have precluded critical discussion, but he, having placed the Nauplius which has just been described, alone in a watch-glass of sea-water, at 9 P.M. on September 28, found on the 29th at 9 A.M. that it had changed into the Zoea form.

This Zoea has the carapace developed in a horse-shoe form, much like that of the king-crab, *Limulus*, and it forms about one-half of the entire length of the animal. The frontal margin is produced anteriorly in the median line to a strong and pointed rostrum, about one-third of the length of the carapace. The posterior margin is concave and produced in the median line into a short tooth that is obliquely elevated, and the postero-lateral angles are produced to long, posteriorly directed teeth. The walls of the carapace are folded down, and laterally compressed, so that all the appendages except the antennæ are almost completely enclosed and protected.

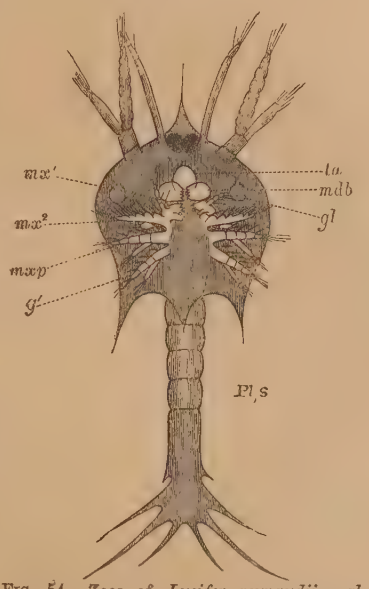

FIG. 54.—Zoea of *Lucifer reynaudii*. *gl*, gland in the carapace; *Pl,s*, provisional segments of the pleon; *la*, labrum; *mdb*, mandible; mx^1, first maxilla; mx^2, second maxilla; *mxp*, maxilliped; g^1, gnathopod.

Dana[1] described and figured two specimens of this form under the name of *Erichthina demissa;* the earliest stage had no eyes visible, only the central ocellus, but in the older one the eye was present in a more advanced stage than that shown in either of Brooks' figures.

This is as far as Professor Brooks was able to trace the development of one specimen, but he has shown from others taken at a similar period that there are three forms that correspond with this Zoea moult.

This stage corresponds with the accompanying figure (fig. 54), taken from Willemoes Suhm's drawings, which he defines, as—

[1] U.S. Explor. Exped. Crust., p. 634, pl. xlii. figs. 3*a–d*.

"A. The youngest Zoea stage without eyes in the development of *Leucifer reynaudii*. Taken north of New Guinea, off Mariannes, March 1875."

"Specimens in this stage were also taken north of Japan."

The second stage differs from the first in having increased from $\frac{20}{1000}$ (0·5 mm.) to $\frac{27}{1000}$ (0·67 mm.) of an inch, measured from the apex of the rostrum to the base of the hairs on the telson. The appendages are similar to those of the first Zoea, but the carapace is elongated, and a pigment-spot represents the future compound eye which is now appearing.

The Zoea previous to maturity loses the caudal spines by shedding the skin.

The third stage Professor Brooks has observed in several specimens, more than fifty having passed through it in the laboratory. The form now corresponds in character with our figure on Pl. LXXIX. fig. 1, which is 1 mm. in length, and was taken in September 1875, in lat. 2° 34′ N.

Claus in his Crustaceen System (Taf. ii. fig. 1) has also figured this stage as an *Erichthina* from a specimen that was taken in the Gulf of Messina, and which he says corresponds with the "larva of *Leucifer* by Willemoes Suhm," but which differs from Suhm's specimen as well as from that figured in this Report, on Pl. LXXIX., which was stained and mounted in Canada balsam by Willemoes Suhm, and is probably that from which he made his drawing, in having the lateral extremities of the carapace rounded as in the young of *Penæus*, instead of being produced to points, as in Suhm's drawings and our figure.

The description agrees with the figure given by Professor Brooks,[1] except in such points as may be attributed to the treatment our preserved specimen received in mounting, or in such details as will be pointed out.

The ocellus is present in our specimen in the form of a circular transparent lens.

The eye is represented by a pigment-spot, which Professor Brooks figures as being on the outer side of the second pair of antennæ, and posterior to the cerebral ganglion, whereas in our specimen it is on the inner side of the antennæ and in contact with the cerebral ganglion, and is much larger and more conspicuous than in Professor Brooks' figures.

The first pair of antennæ consists of a long cylindrical basal joint and a slender terminal one, which ends in two rather long sensory cilia. The second pair is made up of a short, stout, semi-articulate peduncle that supports two branches, one of which, the scaphocerite, is single-jointed and the other biarticulate, each being tipped with several long hairs. The scaphocerite in Brooks' and Suhm's figures is multiarticulate. These are the chief organs of locomotion at this period.

The mandibles cannot be easily determined in our sole specimen, but Professor Brooks describes them as being "cutting blades which are visible in a dorsal view."

"During the first Protozoea stage it (the mandible), has only one denticle, which is

[1] *Loc. cit.*, pl. iv. fig. 42.

large, pointed, and situated at the posterior angle of the cutting edge, but at the second Protozoea stage a number of small denticles have appeared in front of the long one. The mandibles are never quite symmetrical, but the outline of the left always differs a little from that of the right," as shown in the following illustration from Willemoes Suhm's drawings.

Fig. 55.—Mandibles of *Lucifer*.

The first pair of maxillæ consists of a basal portion made up of two joints with "cutting hairs," an inner ramus of two joints terminating in three slender hairs, and an outer ramus with three. In the first stage the hairs of the latter are simple, but on the second they are plumose.

The second maxilla consists of a multiarticulate basal portion, a small biarticulate inner ramus, and a uniarticulate outer branch. The entire inner margin of the appendage carries short stout hairs; the extremity of the inner ramus carries a few somewhat longer, and the outer branch three slender plumose hairs, which are much longer in the second than in the first stage.

The next succeeding appendages, which Professor Brooks calls the first and second pairs of maxillipedes, but which are homologous with the last or third pair of siagnopoda and the first pair of gnathopoda according to the nomenclature in this Report, resemble each other and consist of a two-jointed basal portion, a four-jointed inner, and a single-jointed outer ramus, the former supporting four long slender hairs which are simple in the first pair but regularly ciliated in the second. The second pair is smaller than the first, and apparently of little functional importance. Professor Brooks here notices "a small convoluted shell-gland which appears to open at the base of the first maxilla."

In Suhm's figure of the earlier stage of this Zoea there is represented a small gland (fig. 54, *gl.*) of a similar character, but situated on the outer side in a line with the mandibles, whereas Professor Brooks describes it as being at the base of either the first or second maxilla, he is not sure which, because "the constant and violent movements of the limbs renders it difficult to decide with confidence exactly what its relation to them is."

After the next moult, which Professor Brooks has observed in a great number of specimens, the Zoea passes into a form that is directly comparable, so far as the appendages are concerned, with the Elaphocaris-stage of *Sergestes*,[1] although the most conspicuous features, the long compound spines, are not present in the young of *Lucifer*. It is now about $\frac{50}{1000}$ of an inch (or 1·25 mm) long; the appendages are the same, but the four pairs of pereiopoda and the appendages of the sixth somite of the pleon are present as rudimentary buds. The permanent eye is now well advanced in development, although there is yet no trace of a peduncle, the cornea being simply a modified portion of the

[1] It should be remembered that *Elaphocaris suhmi* has yet no trace of the permanent eye, and Suhm asserts, and his drawing confirms the opinion, that the specimen when he captured it still contained in abundance the cells of the embryonic yolk-mass, a circumstance that strongly suggests that the youngest form of *Sergestes* is a Nauplius in the form of a blind Elaphocaris, and therefore earlier in development than the Protozoea of *Lucifer*.

integument of the carapace. The carapace is longer, narrower and more rectangular in a dorsal view than it was at the last stage, and it makes only about one-third of the total length of the body.

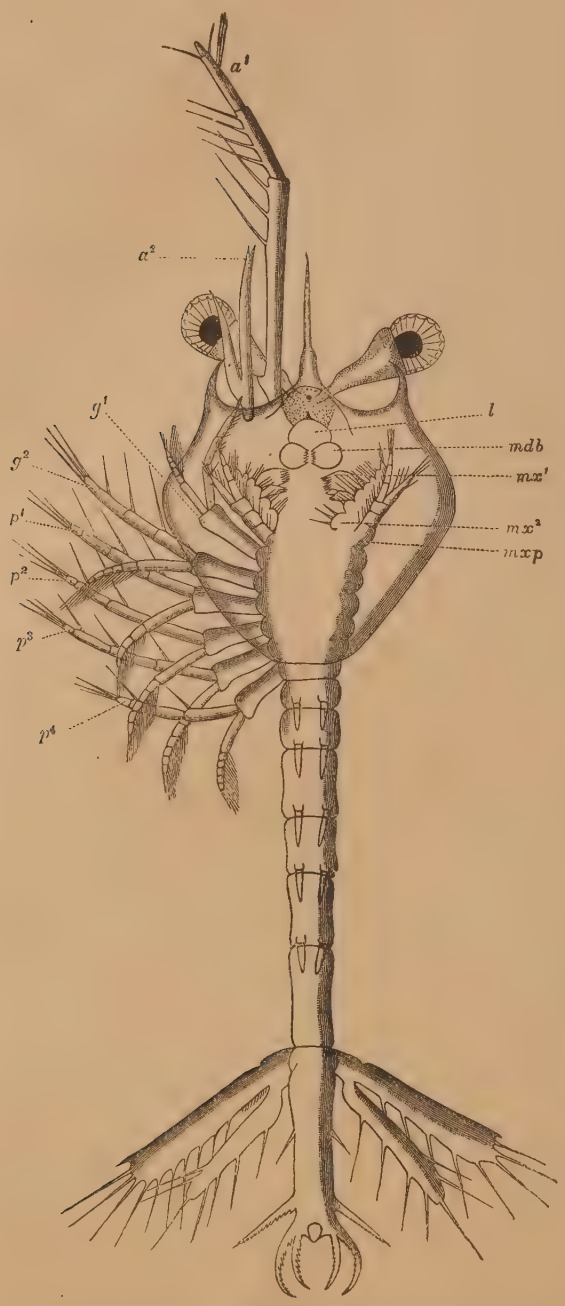

FIG. 56.—*Lucifer* in the Acanthosoma stage, from a drawing by Willemoes Suhm. a^1, first antenna; a^2, second antenna; l, labrum; mdb, mandibles; mx^1, first maxilla; mx^2, second maxilla; mxp, maxilliped; g^1, first gnathopod; g, second gnathopod; p^{1-4}, pereiopoda.

Up to this time, Professor Brooks says the mode of motion has been short, jerking Nauplius-like leaps, and the two pairs of antennæ have been, as they were when the larva left the egg, the chief organs of locomotion. The structure of these appendages has remained extremely constant through all the moults, but they now entirely change their character and lose their locomotive function.

The change which is undergone by the larva at the end of the Zoea series is very much greater than at any preceding moult, except that between the Nauplius and the first Protozoea, and in some respects it is even greater than it was at that time. After the moult it is about $\frac{70}{1000}$ of an inch (or 1·75 mm.) long, with seven pairs of long-jointed, biramose, swimming feet, fringed with long slender hairs. The swimmerets are also present as functional appendages with long fringing hairs.[1]

Professor Brooks' figure was drawn from a Zoea which was captured at the surface of the ocean, carefully examined, and compared with one previously examined (*loc. cit.*, fig. 43), and found to agree with it exactly. It was then placed alone in a small beaker of sea-water. The next day it was found to be moulting, and a drawing was made from it

[1] It should be here noticed that by swimmerets and swimming feet Professor Brooks does not mean the pleopoda that are so named in Crustacea generally, but the immature pereiopoda and their accompanying branches.

immediately after the completion of the change. He also kept several specimens and saw them moult, assuming a form that was a little larger but similar in all respects, except that the appendages of the pleon were now present as small buds. Some of these were kept until they changed into a form strongly resembling a *Sergestes*.

At this stage it appears that the observations of Willemoes Suhm are more distinctly in the true line of development.

"In August 1875, about 300 miles south of the Sandwich Islands, a young Crustacean was captured which was believed to be a stage in the history of *Leucifer*, and which Dr. Suhm named the *Amphion*-stage. It measured as follows:—

"Length, total,	2·67 mm.
„ of rostrum,	0·24 „
„ shield without rostrum,	0·63 „
„ both together,	0·87 „
„ pleon,	1·3 „
„ telson,	0·5 „
„ ophthalmopod,	0·31 „
Diameter of carapace,	0·66 „

"On the second maxilla I could not find a palpus in three specimens that I examined."

The carapace has undergone a considerable change of form. The rostrum is long and prominent, but the teeth on the posterior margin of the carapace both at the angles and median line have disappeared. But on the anterior margin of the carapace each angle external to the ophthalmopoda is projected into a prominent tooth directed forwards, whence the lateral margins are curved downwards and outwards, and then gradually upwards and backwards to the postero-median dorsal surface of the pereion.

In this stage the development corresponds with that known as the Acanthosoma-stage of *Sergestes*, and corresponds with *Sceletina* of Dana. It differs, however, in having the ophthalmopoda long, and, according to Suhm's measurement, one half the length of the carapace, not including the rostrum. The ocellus is still visible as a spot of pigment in the centre of the cerebral ganglia.

The first pair of antennæ consists of four joints sparsely fringed with hairs; the first joint is long, slender, and cylindrical, excepting for a small process on the outer side near the base, the seat of the future acoustic organ; the second joint is less than half the length of the first and slightly less in diameter; the third is about the same length and thickness as the second; and the fourth joint consists of a small papilliform segment, which is the rudiment of the future flagellum.

Fig. 57.—Mandible, from a drawing by v. Willemoes Suhm.

The second pair of antennæ is biramose, the inner being the primary branch of the future organ, which at present scarcely reaches beyond the extremity of the rostrum, and the outer branch is the scaphocerite in an undeveloped condition.

The mandibles are seen in the form of curved plates with a serrate incisive margin (fig. 57).

The first pair of maxillæ is three-lobed; the first lobe is on the inner side of the first or coxal joint, and is crowned with four long stiff hairs; the second lobe springs from the basis or second joint, and is broad, foliaceous, and crowned with seven or eight strong stiff hairs or spines; the third lobe consists of three small cylindrical joints, each of less diameter than the preceding, and furnished each with two hairs; those at the extremity being the longest. These three joints appear to represent the basis, ischium, and meros of the typically developed appendage.

The second pair of maxillæ consists of a single biarticulate branch; the basal joint is long, broad at the base, and tapers towards the extremity, it is divided on the inner surface into five lobes, the largest at the base, the smallest towards the apex, and each is furnished with three long hairs, except the distal one, which has two; the second

Fig. 58.—First maxilla.

Fig. 59.—Second maxilla, from drawings by v. Willemoes Suhm.

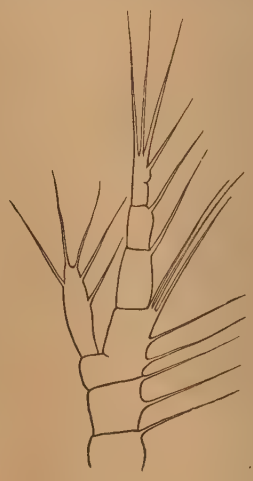

Fig. 60.—Maxilliped.

joint is bilobed, the proximal lobe being furnished with one hair and the apical with three. On the outer margin there is supposed to be an appendage of some sort, as seen in the previous and in future stages, but Suhm says that he could not find it in three specimens that he examined.

The next succeeding pair of appendages is the third siagnopoda or the maxilliped; this Suhm figures as being biramose, the branch springing from the third joint, instead of from the second or basis as is usual. This appendage consists of six joints and a small ecphysis, furnished with several long hairs.

The first pair of gnathopoda has the basisal joint long and robust, carrying two branches, one of which, composed of four joints, is the true limb, and the other a multiarticulate branch.

The second pair of gnathopoda resembles the first in form, but is longer and more important.

The pereiopoda consist of four pairs and are all formed on the same plan as the gnathopoda, which they closely resemble; the posterior pair, according to Suhm's drawing, has only three joints belonging to the primary division, instead of four, as all the others have.

The pleon consists of six somites and the telson.

The pleopoda are in a rudimentary condition, but the sixth pair is well developed and helps to form an efficient rhipidura.

The telson is long, and armed at the sides and extremity with six or eight stiff hairs, the posterior of which have slightly serrate edges.

In the West Pacific Ocean a specimen (Pl. LXXXV. fig. 2) was taken of a species that corresponds with the genus *Sceletina* of Dana, but which Professor Brooks has shown to be the young of *Lucifer*, corresponding with the Acanthosoma-stage of *Sergestes*.

Our specimen is about 1·5 mm. in its entire length, of which the carapace is 0·4 mm., or about one-fourth of the whole length of the animal.

The frontal margin of the carapace is produced to a flat sharply pointed rostrum, whence it recedes in a concave line to the fronto-lateral angle, which is anteriorly produced to a strong sharp point, from which the lateral margin recedes in a waved line to the posterior extremity of the pereion.

The pereion is enclosed within the carapace, and the pleon consists of six somites and the telson; the anterior five somites are subequal in length, and are inferiorly produced to a point on each side; the sixth somite is rather more than twice the length of either of the preceding, and is posteriorly produced on the dorsal surface to a strong point.

The telson is about two-thirds the length of the preceding somite.

The ophthalmopoda are pyriform and about twice the length of the rostrum.

The first pair of antennæ is about twice the length of the ophthalmopoda, and the second pair is about half the length of the first.

The oral appendages were not examined, but Professor Brooks has examined them in a slightly older form; the mandibles are still without the synaphipod that is so conspicuous in the adult; the pereiopoda, which consist of four pairs, are biramose and correspond in form to those of the Acanthosoma of *Sergestes*.

The pleon is yet without any appendages excepting the posterior pair which forms part of the rhipidura, which is biramose and foliaceous, but does not exceed the telson in length.

The next stage, for which we are indebted to Willemoes Suhm's drawing, from which the annexed figure is taken, is described by him as being "a *Leucifer* larva with the divided legs before the moult previous to maturity.

"H $\frac{1}{7} \times 55$ nat. size, 15 March and 1st September 1875. Pacific.

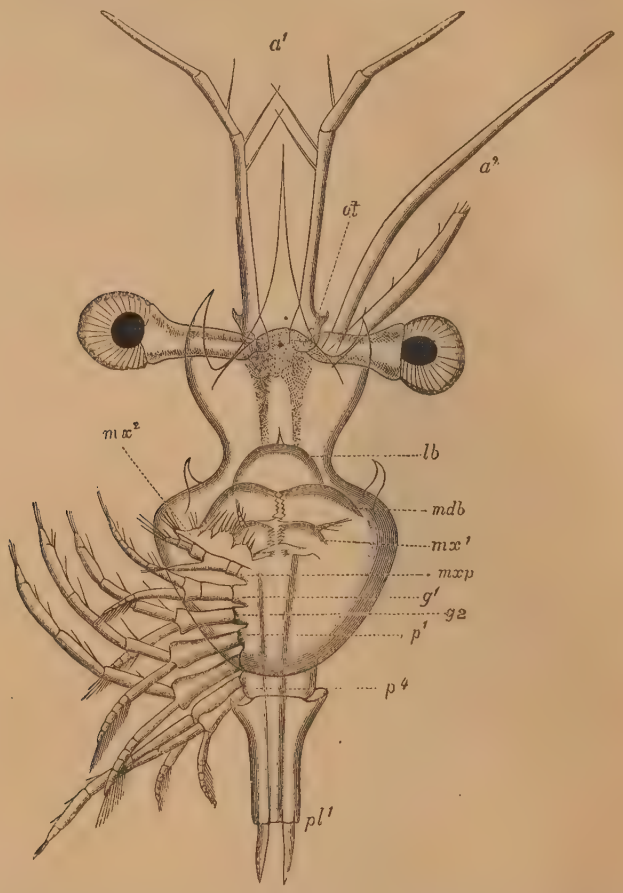

FIG. 61.—*Lucifer*, young, from a drawing by v. Willemoes Suhm; a^1, first pair of antennæ; *ot*, otolith; a^2, second antenna; *lb*, labrum; *mdb*, mandible; mx^1, first maxilla; mx^2, second maxilla; *mxp*, maxilliped; g^1, first gnathopod; g^2, second gnathopod; $p^{1\text{-}4}$, pereiopoda; pl^1, first pleopod.

"Length of rostrum,	0·17 mm.
,, carapace,	0·70 ,,
,, pleon,	1·92 ,,
,, entire,	2·79 ,,
Width of carapace,	0·52 ,,
Length of ophthalmopod,	0·35 ,,
Greatest width of eye,	0·22 ,,

Last (fourth) pereiopod very small. Carapace extended. Otolith visible."

The specimen here detailed is longer than the preceding in the proportion of

2·67 mm. to 2·79 mm.; that is, rather more than one-tenth of a millimetre. All parts appear to have slightly increased in size except the rostrum, which is a little shorter, and the carapace, the width of which has slightly decreased. They may be the young of distinct species, but since both were taken in the Pacific Ocean, they are probably successive stages of the same species.

The great point of interest is the presence of features of the permanent character in the older specimen. The long neck or cervix is for the first time made apparent by means of a deep depression on each side, between the cephalic organs and the oral appendages, and a strong tooth on each side of the oral organs is here distinctly prominent and apparently, from Willemoes Suhm's drawing, relatively more important than in the adult.

The rostrum is still a prominent feature, and projects forwards nearly to the extremity of the first joint of the peduncle of the first pair of antennæ. The tooth on the outer frontal angle is more prominent.

The ophthalmopoda have increased in length, but are not much altered in form, and the ocellus is still visible in the centre above the cerebral mass.

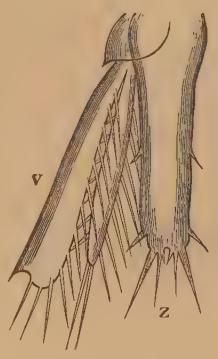

Fig. 62.—"Telson (z) with sixth pleopod (v); seen from above."

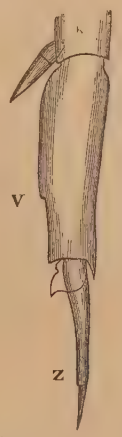

Fig. 63.—v, "Last somite of the pleon with telson attached."

The first pair of antennæ is figured as consisting of three joints, of which the first is long, as in the preceding specimen, the second about one-third the length of the first, and the third longer than the second and terminating acutely as if it were the future flagellum. This probably is divided in the specimen by an articulation that is not immediately distinguishable at the base of the first joint; the future acoustic organ is visible in an incipient condition.

The second pair of antennæ has increased considerably in length, and the scaphocerite has assumed more of the features of the permanent character; the cilia which fringed the inner margin are, however, but few, and very minute and distant.

The carapace has increased but little in length proportionately, but that growth which has taken place is anterior to the oral appendages, thus carrying the antennæ and ophthalmopoda forwards, and commencing the development of that long, neck-like form, which is so peculiar a feature in this genus.

The oral organs do not appear to have undergone any great change, and the pereiopoda, which are still four pairs, correspond closely with those of the preceding, all having somewhat increased in length, except the posterior pair, which is relatively smaller than that of the preceding.

The pleon and its appendages appear to be in the same relative proportion of

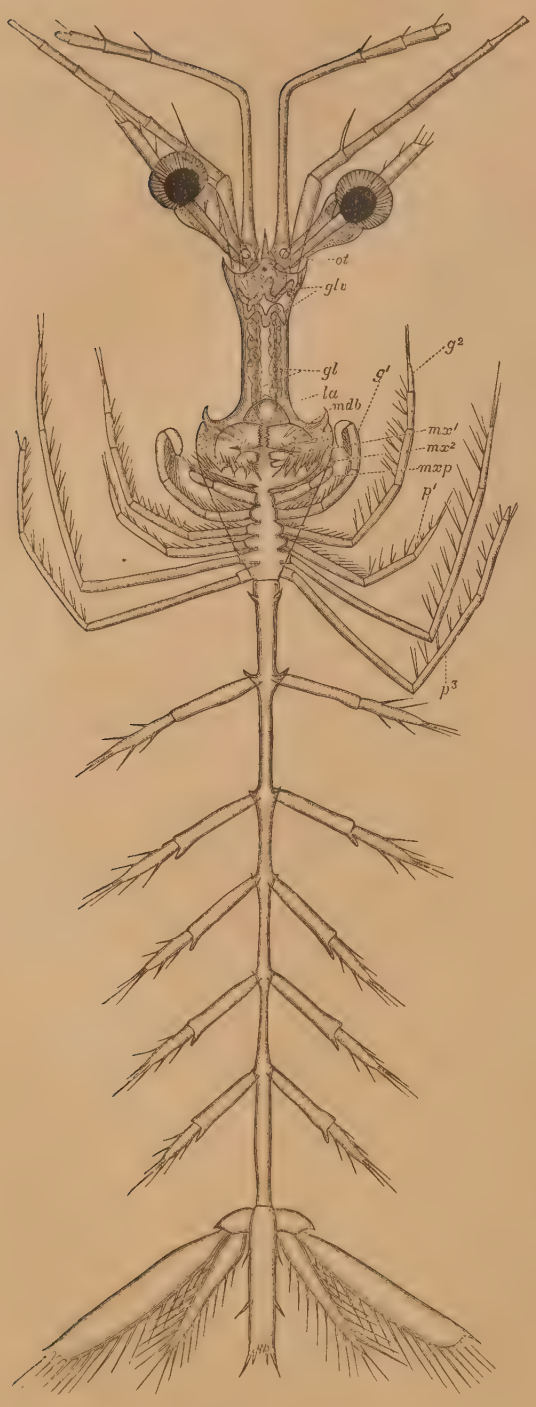

FIG. 64.—*Lucifer reynaudii*, young, from a drawing by Dr. v. Willemoes Suhm. Lettering as before.

development, but the hairs at the extremity of the telson are of a less spinous appearance.

The next drawing to which I have to refer in the development of the species of this genus is one of melancholy interest. It has no date attached, and there are no notes relative to its size and proportions, as all others of Suhm's drawings have. It is labelled by another hand :—

"The last drawing made by R. von Willemoes Suhm. Development of *Leucifer reynaudii*."[1]

The figure is carefully drawn and all its details strictly preserved. It was evidently a labour of love to Willemoes Suhm, and is here faithfully reproduced, one-third smaller to bring it within the compass of the page. The animal in this stage is evidently assuming its permanent characters, but the antennal somite is still shorter and more robust than in the adult. It is evidently the same form as Dana[2] has described and figured as *Lucifer acicularis*.

The rostrum, which in the previous specimen was subequal in length to the first joint of the first pair of antennæ, now reaches but little beyond the acoustic organs at the base of the same pair of antennæ; the antero-lateral angles are still conspicuous points, but less so in proportion than in the younger stages.

The ophthalmopoda are large and well-

[1] Although there were neither figures nor notes attached to this drawing, I have convinced myself, by comparison with the mounted specimens which were preserved and labelled by von Willemoes Suhm, that the separate figures in the text relate to the same specimen from which this drawing was taken.

[2] *Loc. cit.*, p. 674, pl. xlv. figs. *a–d*.

developed organs, probably varying in length in different species, and the ocellus is still conspicuous as a small black spot over the cerebral mass.

The first pair of antennæ consists of four joints, of which the first is very long, nearly equal in length to the carapace, the second and third are short and subequal, while the fourth is but a rudimentary bud; from the inner surface of the inner distal angle of each joint there springs one small hair, and the rest of the appendage is smooth.

The second pair of antennæ is long, apparently longer than is represented in the drawing, which is shortened, and the first pair is bent, probably in order to bring the drawing within the limits of the paper used; the flagellum is multiarticulate, the articuli being long and slender, the first or basal being alone furnished with one small hair; the scaphocerite is long and narrow, with the margins parallel, the inner being fringed with a few separate small hairs or cilia, and the outer produced to a tooth-like point at the distal extremity. With this antenna is connected an internal organ, which is known as the green gland; it consists of a long, tubular ramification folded within a compressed compass smaller than its length. The length of the antennal somite, measured from the

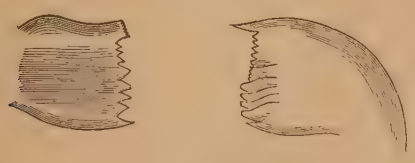

FIG. 65.—Mandible.

FIG. 66.—First maxilla.

anterior margin of the cephalon to the oral apparatus, equals that of the pereion measured from the anterior surface of the labrum to the posterior extremity of the carapace. The diameter of the animal, viewed dorsally, is greatest across the line of the mandibles, from which point the pereion gradually and rapidly narrows until at the posterior extremity it is of the same width as the narrow, compressed somites of the pleon. The epistoma differs from that of the previous specimens in having the tooth, which is a prominent feature in those, reduced to a small lobe.

According to the drawings of Willemoes Suhm, as shown in the adjoining cuts, the oral appendages are approximating to those of the adult, and may be compared with those given on Pl. LXXIX.

The mandibles have the incisive margins serrate, but not uniformly or symmetrically, the one being more deeply toothed than the other.

The first pair of siagnopoda or maxillæ is two-lobed, the distal lobe being the broader, and fringed on the inner margins with a series of simple spine-like hairs, set thickly together, and the basal lobe is narrow and furnished with three serrate and one simple spine-like hairs, and on the posterior margin is a long blunt styliform process.

The second pair of siagnopoda is four-lobed, each lobe distally decreasing in size, and furnished on the inner margin with a series of simple spine-like hairs, three ciliated spine-like hairs and one small and simple; the basal lobe is broader than the middle one but narrower than the distal, and is furnished with four straight, spine-like, ciliated hairs; at the posterior margin, corresponding in position with the middle lobe, is a short but broad ecphysis connected near the middle by a short pedicle, and furnished at either extremity with a series of simple hairs, that become ciliated in the adult stage.

Fig. 67.—Second siagnopod or maxilla.

Fig. 68.—Third siagnopod or first maxilliped.

The third pair of siagnopoda, or first maxillipeds, is biarticulate, the distal joint being fringed on the inner surface with two rows of simple hairs, and the basal with a few solitary hairs of the same character; this organ approximates to that of the adult, but it is more slender.

The first pair of gnathopoda is six-jointed, the several joints being subequal, the terminal one being broader and reflexed upon the preceding; the inner margin of each joint is fringed with simple hairs, the basal joints sparsely, the distal copiously.

Fig. 69.—First gnathopod.

The second pair of gnathopoda is longer than the first, it has no ecphysis and consists of six joints fringed with a series of hairs.

The pereiopoda are reduced to three pairs, the fourth not being reproduced in this stage; none of those present is furnished with an ecphysis, and in general aspect, though not perfectly in detail, they assume the appearance of those of the adult stage. The first pair consists of four joints, of which the basisal is the longest. The second pair is much longer than the second gnathopod, and consists of four joints. The third pair is about the same length as the second, and consists of five joints, of which the terminal is short and rudimentary, and probably becomes in the adult the minute rudimentary dactylos of the microscopic chela.

Each somite of the pleon is armed with a prominent tooth projecting from the lateral margins.

The pleopoda are all single-branched and biarticulate, the four posterior supporting at the distal extremity of the basal joint a small bud-like process, that ultimately develops into the future secondary ramus. The posterior pair of pleopoda together with the telson is developed into a well-formed rhipidura, that bears a close resemblance to that of the adult, the only immature feature being the greater proportion which the

telson bears to the lateral appendages, which are thickly fringed with long, simple hairs.

On the passage from the Admiralty Islands to Japan, a small specimen was taken that has features suggestive of specific difference, but considered in conjunction with its small size—it is scarcely more than one-eighth of an inch in length—I am inclined to believe it to be only a stage in the progressive growth of the animal.

The carapace in this specimen is about one-third of the length of the animal. The cervix is about half the length of the carapace. Rostrum sharp-pointed and obliquely projecting upwards and forwards. I can detect no tooth on the fronto-lateral margin, but a stout and short one exists above the epistoma on each side.

From this stage the young animal rapidly assumes the permanent appearance of the adult, and even so early that specimens which have only attained the length of about 5 mm. possess features that demonstrate their sexual condition.

On Pl. LXXXII. fig. 1, a young specimen (6 mm. long) is represented, which was taken in the tropical part of the Atlantic in the month of April, and which is evidently an immature male, for the petasma, an organ peculiar to the male, exists in a saccular or bud-like form, conspicuously visible on the first pair of pleopoda. In other respects the animal possesses the external appearance of the female, inasmuch as the two strong blunt teeth, conspicuous on the lateral margins of the sixth somite of the pleon in the adult males, are absent, and a feeble point near the posterior angle of the same somite, which is common to females of both the known species, is alone present.

Fig. 70.—v, sixth pleopod; z, telson.

The pereiopoda are as yet in a simple condition; the small dactylos at the extremity of the posterior pair, which gives a minutely chelate character to the appendages in the adult, is wanting. The telson also does not possess the large protuberance on the under surface near the posterior extremity that is apparent in the fully adult male animal, but is smooth and even as in the adult female.

On Pl. LXXXII. fig. 2 represents a specimen about 7 mm. in length, that was taken with several others in which similar features in an incipient condition are present, and the telson is smooth and without any sign of the future protuberance of the adult male, but there are two small teeth, of which the anterior is the larger, on the posterior part of the lateral margin of the sixth somite of the pleon.

On Pl. LXXXII. fig. 3 represents a specimen that was taken in the tropical part of the Atlantic; it is about 8 mm. in length, and in most details corresponds closely with the preceding forms, excepting that it is rather more advanced in development;

the petasma on the first pair of pleopoda is slightly enlarged, and there are three small teeth or points attached to the lateral margins of the sixth somite of the pleon, the central tooth assuming a larger proportion to the others; but the telson still retains the simple condition of the female.

On the same plate, fig. 4 represents another specimen, about 7 mm. in length, that was taken in the tropical part of the Atlantic. This agrees with fig. 2 in most points, and is probably the same stage of a different species; it has, however, lost the minute denticle nearest to the posterior angle of the sixth somite, and apparently retained the larger one anterior to it; it has also lost the small denticle in front of the latter, but further in advance is a small process that appears to be a future tooth; so that we see in an incipient stage the gradual production of the two small teeth that appear to be the constant condition of the males in the species of this genus. The telson still retains its smooth condition.

Whether these several specimens belong to one species or not, it is difficult to determine, but as all species pass through similar stages that resemble each other as far as external evidence enables us to decide, it is most probable that these are derived from the two forms *Lucifer typus* and *Lucifer reynaudii*, which appear to live closely associated together. Dana, speaking of *Lucifer reynaudii*, says :[1]—

"In *one male about half grown*, the anterior tooth of the sixth segment of the abdomen was obsolete, and the posterior spine was quite short, although of the same general character as to its extremity, as in full grown males. This intermediate character in an immature male seems to confirm our inference, drawn from the general identity of character and their frequent association, that the animals described as such are actually male and female."

Geographical Distribution.—The genus appears to range all over the tropical and subtropical regions of the Atlantic and Pacific Oceans, within a hundred fathoms of the surface, but according to Professor Brooks they are abundant on shallow shores.

Lucifer typus, Vaughan Thompson (Pl. LXXXIII.).

Lucifer typus, Vaughan Thompson, Zool. Researches, p. 58, pl. vii. fig. 2, 1829.
Leucifer typus, Milne-Edwards, Hist. Nat. Crust., t. ii. p. 469.
Lucifer typus, Faxon, Chesapeake Zoöl. Lab., 1878, p. 113.
„ *pacificus*, Dana, U.S. Explor. Exped., Crust., p. 673, pl. xlv. fig. 2 (young).

Male.—Antennal somite one-fourth the length of the animal, measured from the frontal margin to the extremity of the telson, and rather more than twice the length of the carapace.

The anterior five somites of the pleon are subequal in length, the first and fifth

[1] U.S. Explor. Exped., Crust., vol. i. p. 673.

being rather longer than the others and a little shorter than the carapace. Each of these somites is furnished with a tooth that projects from the lateral margin, just outside the articulation of the pleopoda (these are not shown in our figure of the male, but they resemble those shown in the female, excepting that they are less prominent and decrease in size posteriorly).

The sixth somite equals in length the two preceding combined, it is dorsally armed with a small tooth at the posterior extremity, and is furnished with two teeth on the lateral margins, the larger of which is about a fourth of the length of the somite distant from its posterior extremity, and the smaller is near the centre; both teeth are straight and directed posteriorly.

The telson is about one-fourth the length of the sixth somite, and is furnished posteriorly on the inferior surface with an obliquely directed lobe.

The ophthalmopoda are long and pyriform, about one-third the length of the antennal somite.

The first pair of antennæ has the first joint of the peduncle rather shorter than the ophthalmopoda; second joint shorter than half the first; third joint shorter than the second, and supports a slender flagellum that is about as long as the antennal somite and carapace together, and has not even the rudiment of a secondary branch.

The second pair of antennæ has the first or coxal joint of the peduncle furnished with a long, projecting, slender tubular phymacerite; the terminal joint reaches anteriorly nearly as far as the extremity of the ophthalmopoda, and is both strong and robust, it supports a terminal flagellum that suddenly becomes very slender and equals in length about one-half of the animal. At the base of the peduncle stands a narrow styliform scaphocerite, quite as long as the ophthalmopoda, and ends in a subapical point.

The epistoma anteriorly projects as a strong protuberance, and inferiorly forms the anterior labrum between which and the metastoma the mandibles are impacted; posterior to which the small foliaceous maxillæ are apparent.

The first pair of gnathopoda has the first three joints anteriorly directed and the last three posteriorly reflexed against them, the sixth or last being long and spatuliform, fringed on the inner margin with long, slender hairs, as is also the penultimate joint, while the antepenultimate is furnished with hairs on the lateral surface.

The second pair of gnathopoda is long, slender, and subequal to the next succeeding or first pair of pereiopoda.

The second and third pairs of pereiopoda are much longer than the first and are subequal in length; the second is simple and terminates in a blunt point, while the third or terminal pair is furnished with a minute, curved, sharp dactylos, which is fringed with long hairs, as is also the inner extremity of the preceding joint.

The first pair of pleopoda is long, slender, and has the basal joint longer than the

terminal; near the centre of the former stands a large petasma, beyond which, on the same surface, is a small projecting calcareous process. The second pair of pleopoda differs from the first in being biramose, the inner branch being short and robust, lobed at the base, obtusely pointed and anteriorly obliquely truncate. The third pair of pleopoda is shorter than the preceding, the two rami are similar in character, but the inner branch is somewhat stouter at the base than the outer. The fourth pair of pleopoda is shorter than the third, and the fifth is shorter than the fourth.

The posterior pair, which forms the outer branches of the rhipidura, has a short basal joint and two long foliaceous branches, the inner of which is fringed with long hairs and is twice the length of the telson, while the outer is about one-fourth longer than the inner and furnished with a small tooth near the distal extremity of the outer margin, the inner margin being fringed with long hairs.

Length, 9 mm. (0·36 in.).

Female.—In general aspect the female bears a close resemblance to the male, and even the differences other than sexual, which I have been able to determine, are such as may not be constant in all specimens. The one under examination is a little larger than the male; it has the ophthalmopoda relatively a little shorter, and the phymacerite slightly longer. It has the first pair of pereiopoda shorter than the second pair of gnathopoda. The pointed processes on the lateral margins, at the base of the pleopoda, are larger and more conspicuous than in the male. The sixth somite has the lateral margins furnished with a single tooth, and that a very small one, one-third of the length distant from the posterior extremity. The pleopoda are generally longer and more slender; the first pair is single-branched and free from the secondary sexual appendage; the second and following pairs are biramose and slender; the terminal pair resembles that of the male. The telson is free from the inferior lobe, terminates in two small spines, and is flanked on each side by another still smaller.

Length, 10 mm. (0·4 in.).

Habitat.—Arafura Sea; near Station 270, Mid-Pacific, lat. 2° 34′ N., long. 149° 9′ W.; Philippine Islands; Port Jackson (female); off Samboangan; West Pacific; Mid-Pacific; St. Paul's Rocks; Tropical part of Atlantic; North Atlantic.

Lucifer reynaudii, Milne-Edwards (Pl. LXXXIV.).

Leucifer reynaudii, Milne-Edwards, Hist. Nat. Crust., t. ii. p. 469.

Male.—Cephalon anteriorly produced in advance of the epistoma to about one-fifth of the length of the animal; dorsal surface produced to a sharp rostrum; a prominent tooth is produced on each side at the inferior antennal angle. The pereion is about one-third shorter than the cephalon; it is deeper posteriorly than anteriorly, and

dorsally protected by a small carapace that rises obliquely from the mandibular region to the posterior margin of the pereion.

The five anterior somites of the pleon are subequal in length and correspond to the length of the pereion. The sixth somite is about half as long again as the preceding one, is posteriorly produced to a small dorsal tooth, and has the under margin armed with two strong teeth, the posterior of which is club-shaped and curved, and the anterior more slender and pointed.

The telson is about one-third the length of the sixth somite and terminates in a small fork, the apices of which are armed with a small spine; on the under surface in the median line is a large protuberance, broad at the extremity and directed forwards.

The ophthalmopoda are nearly as long as the cephalon; the stalk is slender and the ophthalmus bulbous.

The first pair of antennæ has the first joint of the peduncle nearly as long as the ophthalmopod, whereas the second joint is short and reaches just to the extremity of the eye; the third is still shorter, and the flagellum is wanting in every specimen in the collection.

The second pair of antennæ is likewise broken off at the extremity of the peduncle, and supports at the base an extremely slender and pointed scaphocerite.

The appendages of the mouth as well as the pereiopoda exhibit no specific character that enables us to distinguish them from those of the preceding species.

The first pair of pleopoda carries a large leaf-like petasma, has the anterior margin a little below it armed with a strong blunt tooth, and terminates in a single multiarticulate branch. The second pair of pleopoda carries at the extremity of the basal joint, between the two multiarticulate branches, a strong blunt appendage. The third and two following pairs of pleopoda are similar to the preceding, but they do not carry a similar appendage, and each pair is successively shorter than the preceding.

Females.—The female corresponds with the male in general proportions, but is usually a little smaller, although some resemble it closely in size. They can be readily distinguished by the absence of the large teeth on the inferior margin of the sixth somite of the pleon, which are replaced by a small sharp tooth or point situated more posteriorly than are the larger teeth in the male. The telson is also more slender and wants the large tubercle that is so conspicuous in the male.

Their appendages also correspond closely with those of the male, except the pleopoda, which are simple and do not carry a petasma or tooth on the first pair nor a tubular lobe-like appendage on the second, and the outer branch of the rhipidura has the squamous portion produced as far as the extremity of the terminal tooth.

Length, males and females, 10 mm. (0·4 in.).

Habitat.—St. Paul's Rock; North Atlantic; Atlantic; Tropical part of Atlantic (at 200 fathoms, and at night); Fiji Islands; Philippines; Arafura Sea; New

Hebrides; China Seas; near Station 270, lat. 2° 34′ N., long. 149° 9′ W.; Tahiti; Hawaii.

A specimen much resembling that represented in fig. 4, Pl. LXXXII., but little more than half its length, and with the anterior tooth broad and rounded instead of being sharp, was taken on the passage from the Admiralty Islands to Japan.

The anterior five somites of the pleon are dorsally smooth, and there exists a tooth-like projection on the infero-lateral margin, such as is figured in the female of *Lucifer typus*, and in the young of some species.

The sixth somite is not quite so long as the two preceding; the dorsal surface is furnished with a small sharp tooth at the posterior extremity, and the inferior margin is armed near the posterior extremity with a minute sharp tooth, just in front of which is an obtusely pointed lobe.

The telson is long, slender, about half the length of the sixth somite, forked at the extremity and armed on each side with a small sharp spine.

The ophthalmopoda are pyriform, stout, and about half as long as the antennal somite.

First pair of antennæ has the first joint of the peduncle subequal in length to the opthalmopoda; the second and third joints are short and subequal; the flagella are broken off.

The second pair of antennæ carries a long, slender scaphocerite, which terminates subapically in a sharp point, and is subequal in length to the first joint of the peduncle of the first pair; the terminal joint of the peduncle is about half the length of the ophthalmopoda; the flagellum is wanting.

The gnathopoda possess the normal character as in the adult type of the genus.

The pereiopoda are broken off at the distal extremity of the carpos, except one of the posterior pair, which shows the existence of the minute dactylos which makes an imperfect chela.

The pleopoda are long, slender, and decrease in length posteriorly.

The plates of the posterior pair are unequal, the inner not being longer than the telson, and the outer being one-third longer and laterally armed with a tooth near the distal extremity, which is broad and fringed with hairs.

Length, 4 mm. (0·16 in.).

Observations.—The general distinction of this specimen from most others lies in its robust appearance, particularly of the antennal somite, or that portion that separates the antennæ from the oral region. This is, however, a feature attributable to an immature condition, as may be seen in those stages, as in *Sceletina*, where the antennal region is not distinctly separated from the oral and gastric.

On the sixth somite of the pleon, the lobe anterior to the small sharp tooth may be,

and most probably is, the first appearance of the larger tooth that is so conspicuous a feature in the adult male. As yet, there is no evidence, even in a rudimentary condition, of the petasma that forms so important a character in the adult male.

Group ABERRANTIA.

The species that are placed in this group differ from those belonging to the Normalia of this division of the Macrura, chiefly in the varying and eccentric condition of the pereiopoda.

In the Penæidea, these appendages in the highest pronounced types are well developed and constant in form, consisting anteriorly of three chelate pairs, and posteriorly of two simple pairs, but these all diminish in value and importance, as they descend in the scale of the various families.

The two posterior pairs of pereiopoda first appear to suffer degradation and become long, slender, and feeble appendages, useless as organs of locomotion either for walking or swimming. This is apparent in the genera *Benthesicymus*, *Gennadas* and *Benthecætus*. In the two former they are long, slender and styliform, whereas in *Benthecætus* they are long, slender, filiform and multiarticulate. In the Sergestidæ they become still further depreciated, losing much of their power in *Sergestes*, and altogether disappearing in the genus *Acetes*.

In this latter family not only do the two posterior pairs disappear, but the others also suffer considerable degradation, the number of the joints of the first pair of pereiopoda being reduced to six, and it loses its chelate state, and the two following pairs are reduced to a feeble and exhausted condition, and although the chelæ are retained, they are microscopical in proportions.

But with this degradation of the pereiopoda we find an increased power and importance given to the gnathopoda. The first pair, especially, becomes a strong and powerful appendage, furnished with a genuflexed carpal joint, which cannot be extended straight, and indicates its usefulness as a powerful organ of prehension. The second pair also is robust, more especially at the basal joints, and is also a long and powerful organ.

In the Luciferinæ, as in the genus *Acetes*, the two posterior pairs of pereiopoda have disappeared altogether. The first pair of pereiopoda also has still further diminished in value than in the Sergestinæ, and the second pair has lost its chelate character, a feature that is only represented by the minute chela of the third pair.

In this division the branchiæ vary from a condition in which they are the most numerous and finely developed in the order, as in *Benthesicymus*, to their entire disappearance, as in *Lucifer*.

Thus we find that important parts vary, change and disappear, yet the animals possess features that clearly demonstrate they belong to one common division.

Their great nervous system, their manner of fertilisation, their reproduction and, so far as known, their plan of development are similar, and those systemic features which unite the Penæidæ and the Sergestidæ they possess in common with the aberrant Schizopoda.

In some genera the ova are carried in a pouch beneath the ventral surface of the pereion, but this is not a universal characteristic of the group, for in his carefully executed Report on the Schizopoda, Professor Sars has pointed out[1] that, "in the Euphausiidæ incubatory lamellæ are wanting; but even here the position of the ova beneath the trunk is precisely the same as in other Schizopoda," and, it may be added, corresponds with the position of the ova in *Lucifer* as shown by Professor Brooks in his memoir on that genus.[2]

Tribe Schizopoda.

This name as now applied is much more extended, and bears but little reference to the species for which Latreille originally intended it, most of these having been found to be the early stages of some other forms of more or less known adult Crustacea. The name was consequently withdrawn by its author, and, so far as I am aware, does not appear to have been generally adopted until Claus used it in 1862, and it was not employed in any general classification until 1867, when Sars introduced it into his Histoire Naturelle de Norvège and in his recent Report on the Schizopoda of the Challenger Expedition. It will henceforth probably continue to be used as the appellation of this tribe.

Professor Sars says[3] that, in his opinion, "it is more appropriate at present to assign to this group the rank of a distinct tribe or suborder, there being several well-marked characters distinguishing these Crustacea rather sharply from all other known Decapods," but it appears to me that, with the exception of the variable condition of the pereiopoda, the several genera do not possess a single character that is not held in common with some genus of the Macrura.

1. The presence of well-developed basecphyses attached to the pereiopoda, which Sars calls "natatory branches," is common to many genera, especially in immature forms. It was one of the features that induced Milne-Edwards to place the genus *Oplophorus* among the Penæidea, with which it possesses no other important character in common. These being ecphyses, or branches of the pereiopoda, they are incapable of free action to any great extent, independently of the limbs of which they are a part. With the exception of the family Mysidæ, in which the pleopoda in many genera are

[1] Zool. Chall. Exp., part xxxvii. p. 8. [2] *Loc. cit.*, p. 19, 1882. [3] *Loc. cit.*, p. 7.

in a rudimentary condition, and the pereiopoda are in their entirety utilised as natatory organs, it is doubtful if the basecphyses be ever used for simply swimming purposes; and, moreover, I think it to be capable of demonstration that in the pelagic Macrura, when these organs are developed, they are mostly employed for ascending and descending through the various strata of oceanic water, and are of importance in enabling the animals to avoid the strong sunlight at the surface, by permitting them to sink during the daytime, and ascend at night, a periodic movement that has been so frequently noticed to be their habit.

2. The large size of the synaphipod attached to the mandibles in many of this tribe is a feature the animals possess in somewhat inferior degree to that which we see in *Lucifer*, *Sergestes*, and other genera of the Penæidea, more especially in *Gennadas* and *Benthesicymus*, where they frequently reach to the extremity of the ophthalmopoda, but the size of this appendage cannot be considered as being a condition illustrative of the tribe, inasmuch as it is absent in the genus *Stylocheiron*, just as we find it wanting in some genera of the Phyllobranchiata.

3. The pereiopoda are very variable in form and proportion among the several families of which this tribe is composed, when compared with the more normal forms; and the gnathopoda exhibit a persistent tendency to approach to the pediform condition of the pereiopoda, thus illustrating a very constant law that, with the depreciation of the functional power in the pereiopoda, the gnathopoda increase in importance. This appears to me to be only a continuation of the same process that is visible all through the Macrura, and which is strongly exhibited in the Sergestidæ, and becomes more exaggerated in the Schizopoda—leading through the Eucopiidæ, in which we find the pereiopoda departing from the normal form in this division of the Crustacea, and approximating to those of the Amphipoda, in which the first pair of pereiopoda and both pairs of gnathopoda are subchelate. To carry the similitude further, all the somites of the pereion in *Eucopia* complete their dorsal arc as in the Amphipoda; the carapace being only a thin and membranous cloak that loosely overlaps the pereion.[1]

4. The mode by which the ova are carried by the females in the Schizopoda varies. In the Euphausiidæ it corresponds with that of *Lucifer*, and may be the same in the Penæidæ also, but I am inclined to believe that the weight of evidence is in favour of the belief that the ova in the normal group are deposited in the open waters of the ocean. In other families of the Schizopoda they are supported in pouches of different kinds, developed for the purpose beneath the pereion, similar in kind but varying in different genera, like those of the Edriophthalmous Crustacea, or they are carried in sacs as in Entomostracous forms. In the Euphausiidæ, moreover, the males possess a petasma attached to

[1] *Apseudes talpa*, Montagu, appears to approach nearer to this tribe than to the Normal Isopoda. It only wants the extension of the cephalon into the form of a carapace to give it all the characters essential to a perfect Macruran.

the first pair of pleopoda, and this is an appendage that exists in the same peculiar form only in the males of the Penæidea besides. Whether the fertilisation of the female takes place in other Schizopoda in the way it is shown by Sars to occur in the Euphausiidæ, by means of free spermatophores, I do not know, but this is just as it takes place in *Lucifer* (*vide* p. 447 and Pl. LXXXI. figs. 1, 2 of this Report).

5. The development of this tribe exhibits a very striking resemblance to that which is seen in *Lucifer*, and so far as known to other forms of the Penæidea, all of which appear to pass through complicated morphological changes previous to attaining their adult condition.

For these reasons I am inclined to believe that the natural position of these animals is that of an aberrant tribe of the Dendrobranchiata, more nearly allied to the degraded forms of the Penæidea than to those of any other group.

The species in this tribe belong to several genera. Those procured during the expedition of the Challenger have been described by Professor Sars in his Report on the Schizopoda. These he has arranged in the four families given in the table at page 219.

Division PHYLLOBRANCHIATA.

The species of Macrura in this division consist of all those which possess a series of branchial plumes, developed in the form of broad foliaceous plates of extreme tenuity, attached to a central stalk.

They may conveniently be divided into those which are normal in their characteristic features, and those in which there is a greater or less aberrant departure from the more perfect structure.

Group ABERRANTIA.

This group consists of several tribes and families that in their adult condition approach more nearly to the characters common to other divisions, but which nevertheless during the progress of development pass through a stage common to the normal Phyllobranchiate Macrura.

This aberrant group has long been distinguished by carcinologists under the name of the Anomura, sometimes as a division of the Macrura, and sometimes as a distinct order. It is as a separate group of the former that they are here noticed; for undoubtedly in their earlier stages they pass through a morphological change that is essentially Macrurous, in which the scaphocerite and rhipidura are both present as well-developed appendages, the latter of which they never entirely lose.

The acknowledged species of this group belonging to the Challenger collection will be reported on by Professor John R. Henderson, M.B., F.L.S,[1] but there are two or three immature specimens that appear to me not to belong to the normal forms of this division, and I have arranged them under this group, assuming that in their mature condition they may belong to some unknown aberrant species.

Zoontocaris, n. gen.

Carapace less than one-third the length of the animal, not covering the entire pereion, and anteriorly produced to a long rostrum that is broad at the base and sharp at the apex.

First somite of the pleon little broader than the succeeding ones.

Telson gradually increasing in width posteriorly and terminating in a sharp tooth at each angle.

Ophthalmopoda subpyriform and projecting laterally and posteriorly.

First pair of antennæ biflagellate.

[1] Zool. Chall. Exp., part lxix.

Second pair furnished with a long and sharp-pointed scaphocerite.

First pair of pereiopoda chelate.

Pleopoda biramose, ultimate pair unequally branched, shorter than the telson.

Observations.—From every point of view this genus is truly Macruran, having the three great and original characters of a long pleon with well-developed pleopoda, a large powerful rhipidura, and a well-developed scaphocerite attached to the second pair of antennæ.

On the other hand the carapace is broad and depressed, and a longitudinal angular ridge traverses it from the orbit to the posterior angle; beyond which on the ventral surface the carapace is bent inwards after the manner in the Brachyura. I have therefore placed this genus here as belonging to the Aberrantia of this division, thereby assuming that eventually it may be shown to be the young of some genus of the Anomura.

Zoontocaris galatheæ, n. sp. (Pl. LXXXV. fig. 3).

Carapace broad, depressed, anteriorly produced to a long rostrum, broad at the base and tapering to the apex; posterior lateral angle produced to a long and slender pointed process, flanked on each side by a row of teeth that meet beneath its base. Pleon narrow; fifth somite produced to a tooth on each postero-lateral angle. Telson broad, flat, and distally produced to two long pointed processes.

Length,[1] entire,	6 mm. (0·24 in.).
„ of rostrum,	2 „
„ of carapace,	1·5 „
„ of pleon,	4·5 „
„ of telson,	1 „
„ of fork of telson,	0·8 „
„ of sixth somite,	0·9 „
Breadth of carapace,	2 „
„ of pleon,	0·8 „

Habitat.—Off Cape Howe, Australia (Young).

Numerous specimens were taken but that figured and described appears to be the most advanced. They were associated with *Lucifer*, *Oodeopus*, and *Gonerichthys*.

The carapace is short in the median dorsal line, and, measured from the centre of the interorbital space to the posterior margin, it is less than one-fourth of the entire length of the animal. Anteriorly it is produced, unevenly but continuously narrowing from a broad base to the apex, forming a rostrum equal in length to the carapace in the median line. The lateral margins are posteriorly produced to long, pointed, tooth-like processes, and have the margins at their base armed with spine-like teeth that meet beneath the large wing-like processes. The carapace on the dorsal median line recedes

[1] Except when stated otherwise, the measurements are taken in the median line, and the entire length means the length from a point corresponding with the frontal margin of the carapace to the extremity of the telson.

anteriorly considerably beyond the lateral angles, and covers about half the pereion, so that, when viewed dorsally, it appears triradiate, or shaped somewhat like an arrow-head. The somites of the pleon [1] are subequal, gradually lessening in length and breadth posteriorly to the fifth somite, which is slightly longer than the preceding and produced in the form of a blunt tooth on each side at the postero-lateral angles. The sixth somite is a little longer than the preceding and is produced to projecting angles at the postero-lateral extremity. The telson is a little longer than the sixth somite, gradually increases in width posteriorly, and terminates at each angle in a long tooth-like process, the base on the outer side being furnished with two small teeth or spines, and on the inner with five long blunt spines on each side of the median line.

The ophthalmopoda are large, gradually increasing in diameter from the base to the ophthalmus, the peduncle being slightly curved backwards and is longer on the posterior than on the anterior margin.

The first pair of antennæ has the peduncle obscurely divided into three joints, of which the first is short and the others subequal, and terminally supports two very short flagella.

The second pair of antennæ has the flagellum short, and is furnished with a scaphocerite that gradually tapers to a sharp point, and reaches nearly as far as the apex of the rostrum. It is curved, smooth and rigid on the outer margin and fringed with distantly planted hairs on the inner.

The oral appendages have not been examined.

The pereiopoda, which are short and curved inwards, are in an immature condition; the first pair is the largest and subequal and chelate.

The pleopoda are small and biramose but not fully developed. The sixth or posterior pair is furthest advanced but has the rami unequal, the inner branch short and bud-like, the outer long, styliform, and fringed with hairs on the inner margin.

Observation.—The serrature on each side of the postero-lateral angle of the carapace, although not quite similar, is yet suggestive of that in the Zoea form of *Galathea;* hence the specific name.

Zoontocaris approximus, n. sp. (Pl. LXXXV. fig. 4).

Pereion globose. Carapace anteriorly produced to a sharp-pointed rostrum, broad at the base and fringed with small spines; posteriorly produced at each lateral angle to a long and slender tooth, smooth at the base. Pleon narrow, fifth somite armed on each side with a tooth at the postero-lateral angles. Telson broad and terminating posteriorly in sharp-pointed lateral angles.

Ophthalmopoda long, ophthalmus large.

[1] I have erroneously figured the pleon with a somite too few; the lobe shown as the pereion should be divided.

First pair of antennæ with short flagella.
Second pair of antennæ with sharp-pointed scaphocerite.
First and second pairs of pereiopoda chelate.
Sixth pair of pleopoda unequally branched.

Length, entire,	. . . . .	4 mm. (0·16 in.).
„ of rostrum,	. . . . .	1·2 „
„ of carapace,	. . . . .	1 „
„ of pleon,	. . . . .	3 „
„ of sixth somite,	. . . . .	0·6 „
„ of telson,	. . . . .	0·6 „

Habitat.—Taken at the surface, off Mindanao, Celebes, February 6, 1875. One specimen (young).

The carapace only covers part of the pereion, the posterior portion being exposed on the dorsal surface, and together they form a globose or rounded mass. The frontal margin is produced between the ophthalmopoda, where it is wide, to a long and gradually tapering rostrum, which is fringed at the sides with small stout hairs or spines. The postero-lateral angles of the carapace are produced to long teeth, but the margins are smooth and even.

The pleon is less than one-third the width of the carapace and gradually narrows posteriorly. The fifth somite [1] is armed on each side postero-laterally with a small tooth. The last somite is shorter than the preceding, and the telson is broad and flat, gradually increasing in width posteriorly, where it terminates laterally in sharp points surmounted by a strong spine, on the inner side of which the distal margin is fringed with four or five on each side.

The ophthalmopoda are large, curved, and gradually increase in diameter to the ophthalmus, which is obliquely implanted on, and much larger than, the stalk.

The first pair of antennæ has the peduncle three-jointed, the second joint being the shorter and the first and third subequally long; the terminal flagella are short.

The second pair of antennæ has the flagellum subequal in length to the rostrum, and the scaphocerite reaches to the same point, terminating in a sharp extremity.

The oral appendages have not been examined.

The first and second pairs of pereiopoda are larger than the others and subequally chelate, the chelæ being long and broad with the margins corresponding. The other pereiopoda appear to be short, robust and simple, and lie folded against the ventral surface of the pereion.

The ultimate pair of pleopoda is well developed; the inner branch is about half the length of the outer, which is not quite as long as the telson and has the inner margin fringed with hairs.

[1] I have erroneously figured the pleon with too few somites; the lobe shown as the pereion should be divided.

Observations.—Whatever form the ultimate development of this species may assume, I think there can be little doubt that it approximates to that of the preceding species, from which it differs in size and by being more robust comparatively, in having longer eyes, and in the absence of serrature at the base of the posterior angles of the carapace.

Sestertius, n. gen.

Carapace large, one-third the length of the animal, anteriorly produced to a small rostrum.

Pleon slender.

Telson long, and terminally cleft.

Ophthalmus broad and short.

First pair of antennæ having a single flagellum.

Second pair furnished with a broad foliaceous scaphocerite that is rigid on the outer margin.

The first pair of gnathopoda is long, slender, and terminates in a brush of hairs.

The first pair of pereiopoda is robust and chelate; the second is scarcely so robust as the first, and is also chelate; the third, fourth, and fifth pairs are strong but simple.

The pleopoda are biramose; the terminal pair have the branches subequal and well developed as two foliaceous plates.

Observations.—The remarkable feature of this genus exists in the long and slender gnathopod, which is developed somewhat after the manner of that organ in the Schizopod genus *Nematoscelis* as described by Sars;[1] for this reason I have thought it desirable to classify it with the aberrant forms rather than with the more normal types of this division.

Sestertius duplicidentes, n. sp. (Pl. LXXXV. fig. 5).

Carapace dorsally smooth and anteriorly produced to a sharp-pointed rostrum. The pleon is much narrower than the carapace, and each somite except the first is armed with two teeth, one on each side of the median line.

The telson is nearly as long as the sixth somite and terminally cleft.

The ophthalmopoda are short and thick.

The peduncle of the first pair of antennæ is subequal with the length of the rostrum, as is also the scaphocerite of the second pair.

The first pair of gnathopoda is long, slender, and terminates in a few long hairs.

The first pair of pereiopoda is robust and chelate; the second is similar but not quite so large; and the three succeeding ones are simple.

[1] Zool. Chall. Exp., vol. xiii. part xxxvii. p. 126.

The terminal pair of pleopoda is about one-third shorter than the telson.

Length, entire,	. . . . .	5 mm. (0·2 in.).
,, of rostrum,	. . . . .	0·5 ,,
,, of carapace,	. . . . .	2 ,,
,, of pleon,	. . . . .	3 ,,
,, of sixth somite,	. . . . .	1 ,,
,, of telson,	. . . . .	0·7 ,,
,, of first gnathopod,	. . . . .	4·5 ,,

Habitat.—October 27, 1874, Samboangan, Philippine Islands. Taken at the surface. One specimen (young).

October 23, 1874; off Sibago, Philippine Islands. Two specimens.

The carapace is oval, smooth, and anteriorly produced to a rostrum that is about one-fourth the length of the carapace. The anterior margin has a large orbital notch, and the fronto-lateral angle is rounded off.

The pleon is much narrower than the pereion, and has the anterior five somites subequal, and except the first armed on the posterior margin with two small backwardly directed teeth, one on each side of the median line. The sixth somite is about equal in length to the four preceding combined, and terminates in two small dorsal teeth.

The telson (fig. 5z) is about two-thirds the length of the sixth somite, and terminates in the posterior projection of the lateral angles, the cleft between them being armed with five serrate spinules on each side, and one small one in the median line.

The ophthalmus is large, and supported on a thick and short ophthalmopod.

The first pair of antennæ has the articulations of the peduncle not clearly defined, and supports only one flagellum, but as this is only rudimentary, the second flagellum may be in an earlier condition, and not yet visible.

The second pair of antennæ has the flagellum subequal in length with the carapace, and within the exuvium, which appears to be entire, the multiarticulate character of the appendage is apparent (fig. 5*c*); it also supports a scaphocerite that increases distally in breadth, and has the inner margin fringed with hairs, and the outer smooth, rigid, and distally armed with a small tooth.

The mandibles and first two pairs of siagnopoda have not been examined.

The third pair of siagnopoda or the maxillipedes (fig. 5*g*) are short, the basis carrying a two-jointed ecphysis, beyond which there are three small joints.

The first pair of gnathopoda (fig. 5*h*) has the coxa stout, the basis long and cylindrical, and carries distally a short biarticulate ecphysis; the next joint is short, and the succeeding two are remarkably long, slender, cylindrical, and subequal, and terminate in five or six long hairs. The second pair of gnathopoda (fig. 5*i*) is short; the basis is here rather more robust, narrows distally, and terminates in a two-jointed basecphysis,

the distal joint being tipped with five long hairs, and near the base on the anterior margin supports a single-jointed appendage.

The first pair of pereiopoda (fig. 5*k*) has the coxa short and robust, the basis is formed as in the preceding pair, and bears a biarticulate ecphysis at the tip, but instead of only one, there are four or five succeeding joints, forming a perfect limb, which gradually increases in thickness to the middle of the propodos, and then gradually tapers to the extremity; the last joint is obscurely chelate. The second pair of pereiopoda (fig. 5*l*) resembles the first but is slightly less robust. The third pair (fig. 5*m*) is more slender than the preceding but formed on the same plan, excepting that it terminates in a simple dactylos, which is long, straight, and tapering. The fourth pair (fig. 5*n*) is robust and shorter than the preceding, but the basisal joint is short, robust, and without an ecphysis or the prominent process on which it stands in the previous appendages. The fifth pair (fig. 5*o*) is like the fourth but the articulations are not so distinctly marked, except those of the coxa and carpos, and the terminal joints are more slender.

The pleopoda are biramose, the branches being short and supported on a long peduncle; the sixth pair is shorter than the telson, and fringed with hairs on the inner margin.

Observations.—Three specimens were captured in the same district. That from which the appendages were taken was a more or less injured specimen obtained off Sibago. The specimens were approaching the time of shedding the exuvium, and are thus interesting, since the outer dermal tissue represents the form in which the animal was in the previous stage, and the inner that to which it was approaching.

The third pair of siagnopoda exist in the form of short, double-branched, imperfect legs, of which the first joint is short, the second long, and the three terminal very short and immature, while the branch or ecphysis consists of two laterally compressed joints of subequal length, the distal one being fringed with six hairs. The first pair of gnathopoda is also five-jointed; the joints at the base, together with the ecphysis, correspond with those of the preceding pair, but the three succeeding are larger; the first is comparatively short, while the two succeeding joints are each about eight times its length; the second being genuflexed near its articulation.

The second pair of gnathopoda differs in plan from that of the first, inasmuch as the continuation of the true leg consists of only a single, short, uniarticulated joint, tipped with two small hairs springing from the base of the second joint and not from its extremity, whereas the ecphysis or secondary branch is biarticulate like those of the preceding pair, but unlike them is attached to the distal extremity, which is projected considerably beyond it.

The first three pairs of pereiopoda have the basis and its ecphysis formed on the same plan, but the five distal joints are present, enclosed within the exuvium. But the posterior two pairs are not branched.

Group NORMALIA.

This group includes many genera that naturally fall into four tribes, and these again into several families, each having distinguishing features that clearly define it from the others.

The three posterior pairs of pereiopoda, even in the females, are never chelate, whereas the first two pairs generally are, although in the Pandalidæ the first pair is simple and the second only minutely chelate, and in the Haplopodea all are simple.

The ova are carried by the females attached to the pleopoda, and the brephalos so far as known appears in the Zoea stage, with few exceptions, and these are in the Megalopa condition.

Corresponding modifications take place in the different genera, which lead to their being divided according to their external characters and structural conditions, as shown in the following tabular arrangement :—

	Tribe.	Family.	Genus.	Brephalos.
NORMALIA	Crangonidea,	Crangonidæ,	*Crangon*, *Pontophilus*. *Sabinea*. *Pontocaris*.	Zoea.
		Nikidæ,	*Glyphocrangon*, *Nika*.	Megalopa.
		Alpheidæ,	*Athanas*. *Parathanas*. *Cheirothrix*. *Alpheus*, *Betæus*. *Paralpheus*. *Synalpheus*.	Zoea or Megalopa.
	Polycarpidea,	Hippolytidæ,	*Platybema*. *Latreutes*. *Hippolyte*, *Spirontocaris*. *Nauticaris*. *Hetairus*. *Chorismus*. *Merhippolyte*. *Amphiplectus*.	Zoea.
		Pandalidæ,	*Heterocarpus*. *Plesionika*. *Nothocaris*. *Pandalus*. *Pandalopsis*. *Chlorotocus*. *Dorodotes*.	

	Tribe.	Family.	Genus.	Brephalos.
NORMALIA (*continued.*)	Monocarpidea,	THALASSOCARIDÆ,	*Thalassocaris.* *Diaphoropus.* *Kyptocaris.*	
		ATYIDÆ,	*Atya,* *Caridina.*	Zoea.
		PONTONIIDÆ,[1]	*Pontonia.* *(Typton).*	
		CARICYPHIDÆ,[1]	*Caricyphus.* *Rhomaleocaris.* *Anebocaris.*	
		ACANTHEPHYRIDÆ,[1]	*Bentheocaris.* *Acanthephyra.* *Systellaspis.* *Oplophorus.* *Campylonotus.*	
		PALÆMONIDÆ,[1]	*Palæmon,* *Palæmonella.* *Bithynis.* *Brachycarpus.*	Zoea.
		NEMATOCARCINIDÆ,[1]	*Nematocarcinus.* *Stochasmus.*	
		TROPIOCARIDÆ,[1]	*Notostomus.* *Tropiocaris.* *Hymenodora,*	Megalopa.
		STYLODACTYLIDÆ,	*Stylodactylus.*	
		PASIPHÆIDÆ,	*Leptochela.* *Pasiphæa.* *Orphania.*	
		OODEOPIDÆ,	*Oodeopus.*	
	Haplopodea,	HECTARTHROPIDÆ,	*Procletes.* *Icotopus.* *Hectarthropus.* *Eretmocaris.* *Amphion.*	

Tribe **Crangonidea.**

This tribe contains those normal Phyllobranchiata in which the first pair of pereiopoda is subchelate, and the second pair is feeble or imperfect, the carpos being uniarticulate.

Family CRANGONIDÆ.

Carapace dorsally flattened and laterally compressed. Rostrum dorsally flattened; frontal margin laterally extended; posterior margin laterally overlapped by the first somite of the pleon. Pleon laterally compressed posteriorly. Ophthalmopoda short and

[1] I have formed these families since the descriptive part was printed. For their definition see p. 927.

uniarticulate. First pair of antennæ with two flagella. Second with a large scaphocerite and all the joints of the peduncle articulating. Mandibles without a psalistoma or synaphipod. First pair of gnathopoda without a dactylos, and the propodos reduced to a rudimentary condition. Second pair having neither dactylos nor propodos. First pair of pereiopoda robust and subchelate; second pair slender, chelate or simple, having the carpos uniarticulate; third slender and styliform; fourth and fifth simple and robust.

Pleopoda biramose; rhipidura well developed.

Crangon, Fabricius.

Crangon, Fabricius, Suppl. Entom. Syst., p. 410.

Rostrum short, not longer than the ophthalmopod, and dorsally flattened.

Ophthalmopoda extremely short, orbicular.

First pair of antennæ furnished at the base with a broad, flattened stylocerite, and terminating at the extremity in two short flagella.

Second pair of antennæ having a broad scaphocerite and a long slender flagellum.

First pair of pereiopoda robust, subchelate; second pair slender and chelate; third pair slender, subequal in length to the first, and terminating in a sharp styliform dactylos. The two succeeding pairs are more robust than the second and third, and terminate in a long and flattened dactylos.

The branchiæ consist of four pleurobranchial plumes and one small arthrobranchial attached to the articulation of the second pair of gnathopoda, which also carries a mastigobranchial plate reduced to a rudimentary condition; one of the latter also exists on the first pair of gnathopoda in a small but less rudimentary form, and a small branchial plume is attached to the membranous articulation. The entire arrangement may be shown in the following table:—

Pleurobranchiæ,	...	....	1	1	1	1	...
Arthrobranchiæ,	r	1	...	...	...	...	...
Podobranchiæ,	...	...	...	...	...	...	...
Mastigobranchiæ,	1	1	...	...	...	...	...
	h	i	k	l	m	n	o

I have accepted the genus as restricted by Mr. J. S. Kingsley in the memoir[1] in which he revises the genus as known to the earlier carcinologists. There can be no doubt that Leach,[2] Westwood,[3] Hailstone,[4] and more recently Kinahan,[5] felt that a division of the genus must take place, and in this country the separation would sooner have been made, had not Bell, in his work on the British Stalk-eyed Crustacea, reunited

[1] *Proc. Acad. Nat. Sci. Philad.*, p. 411, 1879.
[2] Malacos. Decap. Brit.
[3] *Mag. Nat. Hist.*, vol. viii. p. 266, 1835.
[4] *Mag. Nat. Hist.*, vol. viii. p. 261, 1835.
[5] *Trans. Roy. Irish Acad.*, vol. xxiv. p. 45, Science, 1871.

Pontophilus with *Crangon*, and Kinahan[1] more recently established his several genera on features that are liable to vary.

Development (Pl. LXXXVI. fig. 4; Pl. LXXXIX. fig. 1).—The brephalos of *Crangon*, as it quits the ovum, exists in a form not very unlike that of the Zoea of *Palæmon*.

It has the carapace anteriorly produced to a sharp-pointed rostrum that is about one-third the length of the carapace, but exhibits signs that at its first moult the anterior extremity is lost. The pleon has the posterior margins of the third somite dorsally armed in the median line with a sharp-pointed tooth, and the fifth somite with one on each side of the dorsal surface. The sixth somite is longer than the preceding two, and continuous with the broad and fan-like telson (fig. 4z), the distal margin of which is fringed with seven ciliated spines on each side.

The ophthalmopod exists chiefly as a large ophthalmus, being nearly equal in depth and in breadth, subequal in length to that of the carapace.

The first pair of antennæ consists of a single jointed peduncle that extends beyond the end of the rostrum and terminates in two small flagella, rudimentary in character and tipped with hairs.

The second pair of antennæ has the peduncle consisting of two distinct joints, the extremity of which supports two branches; one, narrow and sharp pointed, represents the future flagellum, the other, broad and distally fringed with hairs, the scaphocerite.

The mandibles are not very dissimilar to those of the adult, and the same is true of the siagnopoda.

The gnathopoda are pediform and seven-jointed, the second joint carrying a long basecphysis, and the seventh tipped with three ciliated hairs.

Four pairs of pereiopoda exist as sac-like buds.

The pleopoda are also in an incipient condition.

Geographical Distribution.—The range of this genus is very great, but so far as I am aware, it is confined to the northern hemisphere. It is found on the sandy shores all round the coasts of Europe, and we have frequently taken an unspotted variety off the coasts of Devon and Cornwall, in from 10 to 50 fathoms of water. Dana records it from the western coasts of North America, from San Francisco, California, and Puget's Sound. Dr. Stimpson recognised a variety from the Pacific coast of North America as a distinct species from *Crangon vulgaris*, under the name of *Crangon nigricauda*, but as its distinction chiefly rests on the colour of the caudal extremity, with very minor and unimportant structural variations, it can scarcely be accepted as forming a distinct species. *Crangon propinquus*, Stimpson, which I also believe to belong to this species, was obtained off the northern shores of Japan. He says that it differs both from *Crangon vulgaris* and *Crangon nigricauda* only in having the fourth somite of the pleon, and sometimes the third also, carinated in the adult.

[1] *Proc. Roy. Irish Acad.*, p. 354, 1862.

Crangon vulgaris, Fabricius.

Crangon vulgaris, Fabricius, Suppl. Entom. Syst., p. 410.

Dorsal surface of the posterior somites of the pleon rounded, without a carina.
Telson not channelled.
Length 52 mm. (2 in.).
Habitat.—Off Yokoska, Japan ; in from 5 to 20 fathoms.

There are three specimens in the collection that correspond very closely with the European species ; one male, one female, one young.

They have no channel on the telson nor a carina on the pleon, but the former is slender and a little larger than the lateral plates—in which point alone they differ from the European type, which has the telson shorter and thicker, and corresponds with those that I take to be *Crangon affinis*, de Haan.

The following are the measurements of the Japanese forms as compared with the British species, and it appears to me difficult to consider them otherwise than as slight variations of the same species :—

	Crangon vulgaris.			= *Crangon affinis.*
	British.	Japanese.		Japanese.
Length, entire,	52 mm. (2 in.).	41 mm. (1·64 in.).		52 mm. (2 in.).
Width,	8 „	7 „		8 „
Length of carapace,	12 „	9 „		11·5 „
„ of rostrum,	1·5 „	1 „		2 „
„ of pleon,	40 „	32 „		40·5 „
„ of third somite,	6 „	5 „		5·9 „
„ of sixth „	7·5 „	6 „		8 „
„ of scaphocerite,	10 „	8·5 „		10 „
„ of first pereiopod,	16 „	13 „		16 „
„ of second „	16 „	13 „		14 „
„ of third „	17 „	15 „		17 „
„ of fourth „	17·5 „	15 „		17 „
„ of fifth „	19 „	16 „		18 „
„ of telson,	10 „	7 „		10 „

Crangon affinis, de Haan (Pl. LXXXVI. figs. 1–3).

Crangon affinis, de Haan, Crust. in v. Siebold, Fauna Japonica, p. 182.
Crangon propinquus, Stimpson, Proc. Acad. Nat. Sci. Philad., p. 94, December 1858.

Dorsal surface smooth, carapace nearly one-third the length of the animal, measured from the base of the rostrum to the base of the telson. Anterior margin furnished with a small, blunt, flattened, dorsally concave rostrum, that scarcely reaches to the extremity of the ophthalmopoda, with a small tooth at the outer angle of the orbital notch and another more advanced on the outer side of the second pair of antennæ.

The dorsal surface is armed with a sharp tooth on the gastric region and another on the hepatic region, on each side in the same line, corresponding with the anterior extremity of the branchial region.

The pleon is about twice the length of the carapace; the somites gradually increase in length posteriorly, and also become laterally more compressed, particularly from the third somite to the sixth, which is flattened on each side. These somites show a slight tendency to a central elevation, which is not apparent until the specimen is dry; it is faintly visible on the third somite, slightly more defined on the fourth, but on the fifth the median line is depressed, while a slight elevation exists on each side. This central depression is repeated on the dorsal surface of the telson, which is narrow and a little longer than the sixth somite, reaches a little beyond the extremity of the lateral plates of the rhipidura, terminates in a sharp point, and is armed on each side with three spines distantly separated.

The appendages correspond closely with the European *Crangon vulgaris*.

Habitat.—Station 233, May 17, 1875; lat. 34° 39′ N., long. 135° 14′ E.; Bay of Kobé, Japan; depth, 8 fathoms; bottom, mud. Eight females. Dredged.

Station 233A, May 19, 1875; lat. 34° 38′ N., long. 135° 1′ E.; off Japan; depth, 50 fathoms; bottom, sand. Four specimens, females. Dredged.

Station 233B, May 26, 1875; lat. 34° 18′ N., long. 133° 35′ E.; off Japan; depth, 15 fathoms; bottom, blue mud. Three females and one male (?) with *Bopyrus*. Trawled.

Three of the specimens which have been brought from the last locality are females bearing many ova; the fourth is small and slender, and has been attacked by a species of *Bopyrus*.

The only differences that I can recognise between the British *Crangon vulgaris* and these specimens of *Crangon affinis*, are that the latter genus has the rostrum and ophthalmopoda a trifle longer, the ventral tooth between the second pair of pereiopoda more slender and perpendicular, and that the posterior somites of the pleon exhibit traces of an elevation in the median line, but certainly not worthy of being called a carina; a depression also exists in the same position on the sixth somite as well as on the telson.

In the typical specimen of *Crangon vulgaris*, the dorsal surfaces of the last somites of the pleon and the telson are smooth and rounded, but there is a certain average number in which there is an indication of a slight dorsal depression in the median line of the sixth somite and at the anterior extremity of the telson, which latter is a little shorter than the lateral caudal plates in the typical British species, but reaches a little beyond them, and is also a little slighter in the Japanese *Crangon affinis*.

Stimpson obtained some specimens, which he named *Crangon propinquus*, from the northern coast of Japan. They were taken on a muddy and sandy bottom, at a depth of from 4 to 20 fathoms. These he describes as closely approximating to *Crangon vulgaris*,

but having the fourth somite of the pleon, and sometimes also the third, carinated in the adult; and the telson is laterally armed with six spinules. This corresponds with the normal condition of *Crangon affinis*, as well as with the European type. The slight variations between the two forms, though constant, do not appear of sufficient importance to lead me to consider them as specifically distinct, and it is doubtful if the Japanese specimens can be considered to possess features that are sufficiently important to warrant specific distinction.

The late Professor Kinahan,[1] however, considered the channelling of the dorsal surface of the posterior somites of the pleon so important that he founded the genus *Steiracrangon* on this feature alone. That it may be sufficiently marked in some forms as to be of specific value is probable, but it is so slight in the Japanese specimens that it is only appreciable when carefully examined, and I do not think we are justified in considering it as more than a variation in form from the normal European species. De Haan states that *Crangon affinis* possesses the fluted telson, and that the lateral spines of the carapace are larger than the median. But this is scarcely the case in our specimens, since in well-formed animals the spines are equally well developed.

The only distinction that is at all appreciable exists in the different lengths of the telson, but this difference is too slight to warrant its recognition as a specific character; it rather demonstrates the line of departure under certain conditions in which variation may proceed. Two of the specimens from Yokoska that I attribute to *Crangon vulgaris* were taken in somewhat shallower water, and approximate nearer to the European form. But since de Haan, Stimpson, and Kinahan have thought the channelling of the dorsal surface of the telson to be sufficiently important to be of specific value, and as the Japanese form has been distinguished by a specific name, I have thought it preferable to retain de Haan's name "*Crangon affinis*," which I have no doubt is also synonymous with *Crangon propinquus*, Stimpson.

Pontophilus, Leach.

Pontophilus, Leach, Malacos. Decap. Brit., Tab. ix.

Like *Crangon*, but has the second pair of pereiopoda short and chelate, the third long and styliform. There are seven pairs of branchiæ, including a small podobranchial plume attached to the first gnathopod. The branchial arrangement may be tabulated as follows:—

Pleurobranchiæ,	...	1	1	1	1	1	1	
Arthrobranchiæ,	...	...	...	...	...	...	...	
Podobranchiæ,	1	...	...	...	...	...	...	
Mastigobranchiæ,	1	r	...	...	...	...	...	
	h	i	k	l	m	n	o	

[1] *Loc. cit.*, p. 58.

The species of this genus are generally more slender than in *Crangon*, a circumstance partially due to the increased length of the sixth somite of the pleon. The rostrum is longer and generally extends beyond the extremity of the ophthalmopoda, it is somewhat compressed laterally, and never dorsally flattened as in *Crangon*, and the body of the animal is slightly compressed laterally.

The ophthalmopoda are short and the ophthalmus orbicular.

The first pair of antennæ has the flagella longer than the peduncle, and the stylocerite is more styliform than in *Crangon*.

The second pair of antennæ and the oral appendages offer no very decided character for generic distinction.

The first pair of gnathopoda carries a small podobranchial plume attached to the mastigobranchial lash. The second pair is longer and more slender, but, like that of *Crangon*, is only five-jointed, and supports a small basecphysis and the rudiment of a mastigobranchial organ.

The first pair of pereiopoda closely resembles that of *Crangon*, being subchelate and robust; the second also resembles that of *Crangon* in being chelate, yet it differs in being short, slender and feeble; it only reaches to the mouth, to which it most probably carries food. The third pair is long, slender and styliform, the length being chiefly due to the terminal three joints, the carpos, propodos and dactylos. The posterior two pairs are long and robust.

The pleon is ventrally smooth, and the pleopoda are foliaceous, and furnished with two stylamblydes both in the male and female, attached to the inner branch of every pair except the first.

The posterior pair, which forms the outer plates of the rhipidura, is long, narrow, and furnished with a diæresis. The telson is long and narrow, but shorter than the lateral plates.

Geographical Distribution.—The range of this genus is probably cosmopolitan, and in tolerably deep water. Specimens of four species have been taken in the British seas, and in the Challenger collection there are species from the Celebes Sea, mid-south Atlantic, New Zealand, and the Philippine Islands.

Pontophilus gracilis, n. sp. (Pl. LXXXVII.).

Carapace armed with three teeth on the median ridge, two close together on the gastric region and one above the cardiac, one on each side near the middle of the lateral carina, and a hepatic tooth just anterior to the branchial region.

Pleon smooth, third somite longer than the fourth.

Length, entire (female),	64	mm. (2·5 in.).
„ of carapace,	17	„
Width between hepatic teeth,	8	„
Length of rostrum,	3	„
„ of pleon,	47	„
„ of third somite of pleon,	7·5	„
„ of sixth „ „	10	„
„ of scaphocerite (from frontal margin),	10	„
„ of first pereiopod,	26	„
„ of second „	11	„
„ of third „	25	„
„ of fourth „	25	„
„ of fifth „	24	„
„ of telson,	12	„

Habitat.—Station 133, October 11, 1873; lat. 35° 41′ S., long. 20° 55′ W.; near Tristan da Cunha; depth, 1900 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·4. One specimen, female; length 62 mm. Trawled.

Station 168, July 8, 1874; lat. 40° 28′ S., long. 177° 43′ E.; off New Zealand; depth, 1100 fathoms; bottom, blue mud; bottom temperature, 37°·2. Six specimens; three males and three females, one bearing ova; length 35 mm. Trawled.

Station 184, August 29, 1874; lat. 12° 8′ S., long. 145° 10′ E.; near Torres Strait; depth, 1400 fathoms; bottom, Globigerina ooze; temperature, 39°·0. One specimen, male. Trawled.

Station 198, October 20, 1874; lat. 2° 55′ N., long. 124° 53′ E.; near the Philippine Islands; depth, 2150 fathoms; bottom, blue mud; bottom temperature, 38°·9. Two specimens, females. Trawled.

The animal is long, slender, and graceful. The rostrum is sharp-pointed, reaches a little beyond the ophthalmopoda, and is flanked by two small teeth. The median line of the carapace is slightly carinated, armed with three spines, two near together on the gastric region, the third halfway between the second and the posterior margin of the carapace, where the carina fades away. On each side, defining the separation of the branchial from the cardiac regions, is another small ridge or carina running continuously from the posterior margin of the carapace to the orbit, it is armed with a single tooth near the middle, anterior to which the carina is faintly marked. Another small tooth, the hepatic, defines the separation of the branchial from the antennal region. The orbit is deeply excavate, and the frontal margin of the carapace is laterally projected forwards to nearly the same level as the eyes and rostral apex; it is armed with a tooth at the outer canthus of the orbit, and another at the fronto-lateral angle, just beyond the second pair of antennæ. The pleon is smooth, the posterior somite having the sides much compressed.

The telson is long, narrow, dorsally slightly flattened anteriorly, the sides depressed

and the posterior extremity furnished with four hairs. The ventral surface of the pereion and pleon from the oral cavity to the telson is smooth, without any spine or tooth, but a small lobe exists between the second pair of pereiopoda.

The ophthalmopoda are not large, being well hidden within the orbital cavity; the surface of the ophthalmus is smooth, destitute of pigment generally and not visibly faceted.

The first pair of antennæ carries on the outer surface a broad thick stylocerite, which springs from the base and reaches to the distal extremity of the first joint, on the under and inner side of which is a short thick tooth; the second joint is shorter than the first, and the third shorter than the second. The two terminal flagella reach a little beyond the extremity of the scaphocerite of the second pair; the inner flagellum is a little longer than the outer, and furnished on the inner margin with a fringe of long hairs.

The second pair of antennæ has the scaphocerite, which is equal to half the length of the carapace, thick and ridged, with the margins subparallel, the outer terminating in a sharp tooth. The flagellum is broken off near the base in the only specimen procured from this station.

The second pair of gnathopoda does not reach beyond the distal extremity of the scaphocerite and is furnished with hairs, some of which are smooth and others delicately ciliated. The basecphysis, or branch springing from the basis (the exognathe of Milne-Edwards), is short, reaching, when extended, to nearly the length of the ischium; the mastigobranchia (epignathe of Milne-Edwards) is reduced to a rudimentary condition.

The first pair of pereiopoda has the anterior margin of the palm broader than the propodos, incisive, convex, not very oblique; pollex long and sharp; dactylos smooth and sickle-shaped. The second pair is short and feeble, extending scarcely to the distal extremity of the meros of the first pair; chela with fingers long, slender, tapering and meeting only at the points. The third pair is long and slender, extending beyond the distal extremity of the scaphocerite of the second pair of antennæ. The fourth and fifth pairs are slender, subequally long and robust.

The first pair of pleopoda (p ♂, p ♀) has the internal branch rather more than half the length of the external, and perfectly free from cilia, but with one or two short spines on the outer side; the external branch in the male is long, narrow and leaf-like, and fringed on each side with plumose hairs. In the type specimen all the hairs are rubbed off. The second (q ♂, q ♀), third and fourth pairs of pleopoda differ from each other in but a slight degree. Each consists of a pair of nearly equally long, large, ovate, foliaceous plates, fringed with long plumose cilia; the inner branch carries a stylamblys attached to it.

The posterior pair, which forms the outer plates of the rhipidura, is rather longer than the telson; the outer branch has a strong ridge on the outer margin which terminates in a subapical tooth; the inner branch is longer, narrower, and more pointed.

Observations.—The type specimen was obtained at Station 133, associated with specimens of *Willemœsia leptodactyla*, and *Hemipenæus spinidorsalis*. The smaller specimens, taken off the eastern coast of New Zealand, at Station 168, in 1100 fathoms, bear a very close resemblance to it, and I am not able to determine any distinction, excepting that the anterior tooth on the gastric region is almost rudimentary.

One specimen only was taken with ova, and that was trawled at Station 168. The ova are larger than those of *Crangon*, oval in form and less numerous, and they are not attached like them to the pleopoda, but connected together by a very slender filament; they lie against the ventral surface of the pleon, protected especially by the inner branches of the pleopoda.

Pontophilus profundus, n. sp. (Pl. LXXXVIII. fig. 1).

Rostrum reaching beyond the ophthalmopoda. Carapace armed with two strong teeth in the median line, one on the gastric region, the other just anterior to the cardiac region, and two on each side on the branchial region. The third somite of the pleon is dorsally produced to an obtuse point; fourth somite short and partially covered by the third.

The second pair of gnathopoda is long and slender, as is also the posterior pair of pereiopoda.

Length, entire (male),	15	mm. (0·6 in.).
,, of carapace,	3·5	,,
,, of pleon,	11·5	,,
,, of sixth somite,	3·5	,,
,, of telson,	3	,,

Habitat.—Station 165, June 17, 1874; lat. 34° 50′ S., long. 155° 28′ E.; off Sydney; depth, 2600 fathoms; bottom, red clay; bottom temperature, 34°·5. One specimen, male. Dredged.

Body slender, rostrum sharp, extending to a little beyond the extremity of the ophthalmopoda, and flanked on each side at the base by two small teeth, just above the posterior margin of the orbit. Two strong, anteriorly directed teeth; equidistant from each other and from the apex of the rostrum and the posterior margin of the carapace, are situated one before the other in the median line; on each side, just on the margin of the branchial region, there is also a sharp tooth, and anterior to it, separating the branchial from the gastric regions, is another similar tooth. The frontal margin is armed with two short, sharp teeth, one defining the outer angle of the orbit, the other situated just above the infero-anterior angle of the carapace. The ophthalmi are ovate and tolerably large and prominent. The facets (fig. 1*a*) are squares.

The first pair of antennæ has the first joint of the peduncle rather long, and excavate

on the upper surface for the reception of the ophthalmopod; second and third joints short, the last supporting the two terminal flagella, which are equal in length and nearly equal in thickness, the outer being rather the larger, which may be due to sexual distinction; neither reaches much beyond the extremity of the scaphocerite.

The second pair of antennæ has the scaphocerite more than half the length of the carapace, long, narrow, having the inner margin subparallel with the outer, armed with a sharp tooth at the distal extremity of the outer margin; the flagellum is about the length of the animal and consists of a series of long, naked articuli.

The second pair of gnathopoda (fig. 1*i*) is pediform, terminating in an obtuse point; the lower or posterior margin of the terminal, as well as of the two preceding joints, is fringed with two rows of short spines minutely ciliated, while the upper or anterior margin bears fasciculi of long, slender hairs, some of which are finely fringed with long cilia.

The first pair of pereiopoda has the meros armed on the upper and distal angle with a strong, sharp tooth, and the carpos on the inner and lower distal angle with one not quite so prominent; the propodos is long, with parallel margins, the anterior margin (fig. 1*k*), which is very oblique, carrying a sharp tooth-like pollex and a row of equidistant hair-like structures impacted in the thin vertical incisive margin; dactylos sickle-shaped and smooth. The second pair of pereipoda (fig. 1*l*) is short, reaching only to the extremity of the meros of the first pair, slender and chelate; the pollex and dactylos are equal in length, long, slender and convex, terminating in long, slender ungues that impinge only at their extremities. The two succeeding pairs of pereiopoda are partially wanting in the only specimen procured, but the terminal or fifth pair is tolerably robust, longer than the first pair, and terminates in a long, slender, slightly curved dactylos.

First pair of pleopoda (fig. 1*p* ♂) having one branch large and fringed with a few strong hairs, the other short and styliform. The four following pairs have the branches equal, long, ovate, and fringed with long plumose cilia.

The posterior pair, forming the lateral plates of the rhipidura, reaches quite to the extremity of the telson, and has the outer plate armed at the outer distal angle with a short, sharp tooth.

Telson long, narrow, armed at two-thirds distance from the base with two small teeth, and terminating in two stout spines and several strong hairs (fig. 1*z*).

In the same bottle was the second pereiopod of a species of *Lysmata* or a near ally.

Pontophilus junceus, n. sp. (Pl. LXXXVIII. figs. 2–4).

Carapace having two teeth on the dorsal median line behind the rostum, one on the gastric region, the other on the anterior margin of the cardiac. Also one on the lateral

ridge, which is but imperfectly developed, and one on the hepatic region. The pleon is smooth and the caudal appendages are long.

Length, entire,	38	mm. (1·5 in.).
„ of carapace,	9	„
Breadth between hepatic teeth,	4·5	„
Length of rostrum,	4·5	„
„ of pleon,	29	„
„ of third somite,	5	„
„ of sixth somite,	6·5	„
„ of telson,	7	„
„ of scaphocerite,	7	„
„ of first pereiopod,	12	„
„ of second pereiopod,	5	„
„ of third pereiopod,	(?) 20	„
„ of fourth pereiopod,	16	„
„ of fifth pereiopod,	16	„

Habitat.—Station 200, October 23, 1874; lat. 6° 47′ N., long. 122° 28′ E.; between the Philippines and Borneo; depth, 250 fathoms; bottom, green mud. One specimen, female. Trawled.

This species looks very like *Pontophilus gracilis*, but it is only half the length and has but one tooth on the gastric region. The rostrum is sharp, longer than the ophthalmopoda, and has no small denticles on each side of its base. There are six teeth on the carapace, one on the gastric region, one on the cardiac, one on each side on the hepatic, and one near the centre of the lateral wall of the carapace. The sixth somite is scarcely so long as in *Pontophilus gracilis*, but the telson is quite as long, and the appendages generally have a slender appearance, particularly the second and third pairs of pereiopoda.

It may be distinguished from *Pontophilus profundus* by the posterior dorsal surface of the third somite of the pleon not being produced so as to almost cover the fourth.

Sabinea, Owen.

Sabinea, Owen, Appendix to Ross's Narrative of a Second Voyage in Search of a North-West Passage, p. lxxxii, 1835.

Carapace about one-fourth the length of the animal, dorsally flattened and laterally compressed, anteriorly produced to a rostrum that is scarcely longer than the ophthalmopoda.

Pleon dorsally interruptedly carinated on the second, third, and fourth somites only.

Telson long and tapering.

Ophthalmopoda short and orbicular.

First pair of antennæ biflagellate, short.

Second pair having a long, slender flagellum, and a scaphocerite that reaches beyond the peduncle of the first pair.

Oral appendages as in *Crangon*.

Second pair of gnathopoda four-jointed, the ultimate joint but slightly longer than the penultimate and terminating in an obtuse point.

First pair of pereiopoda robust, long and subchelate, like those of *Crangon*, which it much resembles. Second pair of pereiopoda short, feeble and simple, terminating in a small obtuse and rudimentary dactylos. Third pair long, slender and styliform; on the ventral surface of the pereion between this pair of appendages there stands a long, slender, spine-like tooth. Posterior two pairs of pereiopoda robust, subequal and simple.

The branchiæ consist of seven pairs arranged as in the genus *Pontophilus*, namely, six pleurobranchiæ and one podobranchia, disposed as shown in the following table :—

Pleurobranchiæ,	...	1	1	1	1	1	1
Arthrobranchiæ,	...	...	...	...	...	...	...
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	1	r	...	...	...	...	...
	h	i	k	l	m	n	o

Development.—The brephalos appears to be further advanced than the Zoea stage. I only know it as an advanced embryo extracted from the ovum, but even then it has the carapace largely developed, the pleon well formed, the ophthalmopoda large and orbicular, the antennæ assuming their distinguishing character, and the pleopoda in a budding condition. The whole form is suggestive of the genus *Nebalia*.

Geographical Distribution.—This genus was first described by Professor Owen from specimens taken in the Arctic regions. It has since been taken in the Atlantic, off the western coast of America, as far south as 40° of north latitude, and Stimpson records it from the Siberian Seas.

Sabinea septemcarinata (Sabine) (Pl. LXXXIX. fig. 2; Pl. XC. fig. 1).

Crangon septemcarinata, Sabine, Suppl. to Parry's First Voyage for the Discovery of a North-West Passage, p. ccxxxvi, pl. ii. figs. 11–13, 1824.
„ „ Ross, Appendix to Parry's Polar Voyage, p. 203, 1824.
Sabinea septemcarinata, Owen, Appendix to Ross's Narrative of a Second Voyage in Search of a North-West Passage, p. lxxxii, 1835.
Crangon septemcarinatus, Milne-Edwards, Hist. Nat. Crust., vol. ii. p. 343, 1837.
Sabinea septemcarinata, Sars, Forhandl. Vidensk. Selsk. Christ., 1858, p. 125, 1859.
„ „ Stimpson, Proc. Acad. Nat. Sci. Philad., p. 94, 1860.
„ „ Sidney Smith, Trans. Connect. Acad., vol. v. pt. 1, p. 57, pl. xi. fig. 5.
„ *sarsii*, Sidney Smith, *loc. cit.*, p. 59, pl. xi. fig. 6.

Length, entire,	53 mm. (2·1 in.).
„ of carapace,	13 „
„ of rostrum,	4 „
Width of carapace,	10 „
Length of pleon,	40 „
„ of third somite,	8 „
„ of sixth somite,	8 „
„ of telson,	10 „
„ of first pereiopod,	16 „
„ of second pereiopod,	8 „
„ of third pereiopod,	20 „
„ of fourth pereiopod,	18 „
„ of fifth pereiopod,	18 „
„ of scaphocerite,	10 „
„ of ventral tooth,	4 „

Habitat.—Station 49, May 20, 1873; lat. 43° 3′ N., long. 63° 39′ W.; south of Halifax, Nova Scotia; depth, 85 fathoms; bottom, gravel, stones; bottom temperature, 35°·0. Twenty-two specimens. Both sexes; all sizes from 20 mm.

The Challenger specimens of this species correspond most nearly with Sidney Smith's description of *Sabinea sarsii*, which I take to be a pronounced variety of this species rather than specifically distinct. In a letter to me on the subject Mr. J. S. Kingsley of Salem, in the United States, says:—"We have the same in the Museum of the Peabody Academy, dredged off Salem in 90 fathoms. It differs somewhat in the shape of the rostrum from Sabine's figure, and I have no opportunity of comparing it with Arctic specimens. Professor Smith and I were at first inclined to call it a new species, but I now consider it (and I think Professor Smith has come to the same conclusion) merely a variety of Sabine's species. I find that the sternal spine varies considerably, in some specimens it is sharp, while in others it is stout and obtuse."

In our specimens the sternal tooth (Pl. XC. fig. 1) is generally sharp, and in the young, and in those that I take to be males, the tooth is more compressed against the sternum than in the larger females. The two posterior pairs of pereiopoda on the under side of the basisal joint are furnished with a small mat of hairs. The rostrum is dorsally flattened posteriorly, and laterally compressed anteriorly, and the dorsal ornamentation shows an approximation to that which is seen in *Pontocaris*.

The pleopoda are foliaceous; in the first pair there is a sexual modification of the inner branch, which in the male (Pl. XC. fig. ♂ 1*p*) is reduced to a rigid flattened appendage, fringed with a few short hairs, mingled with short, sharp pointed, and slightly curved spines, three or four of which are situated at the inner distal extremity of the basal joint; in the female (Pl. XC. fig. ♀ 1*p*) the arrangement is similar, only the hairs are longer and the small spine-like points are represented by long and flexible

membranous hair-like appendages, and the basal joint is fringed on the inner side with a thick mat of ciliated hairs.

The eggs are ovate and larger than in *Crangon*, and the brephalos probably quits the ovum in a more advanced condition, inasmuch as in the embryo I have been able to detect the pleopoda in a budding state of development.

Pontocaris, n. gen.

Rostrum short, not longer than the ophthalmopoda. Fronto-lateral margin of the carapace much dilated and anteriorly produced. Dorsal surface multicarinated. General appearance as in *Crangon*, except that the scaphocerite is not longer than the peduncle of the first pair of antennæ. The second pair of gnathopoda is long, reaching beyond the distal extremity of the first pair of antennæ, and is furnished with a short basecphysis but no mastigobranchia.

The first pair of pereiopoda is robust, subchelate, and furnished with a short uniarticulate ecphysis attached to the basis. The second pair is slender, nearly but not quite as long in proportion to the first as in *Crangon*, and chelate. Third pair long, slender and styliform, reaching beyond the extremity of the first pair. The two posterior pairs are simple and robust.

The pleopoda are broad and foliaceous, and the outer plate of the rhipidura has no diæresis.

This genus differs very considerably in its external appearance from *Crangon*, most conspicuously in the development of the antennal region and the frontal margin of the carapace, which is dilated and produced in the form of small wings. But a careful examination of the several parts shows that the two genera approximate to each other in detail. All the appendages of the cephalon and pereion closely agree with those of *Crangon*, and the differences distinguishing the two are of little value. The ophthalmopoda are smaller in *Pontocaris* than in *Crangon*, and the first pair of antennæ has the outer flagellum larger at the base; the scaphocerite of the second pair is short and discoidal, while in *Crangon* it is long and narrow; and the mandibles and oral appendages have no appreciable distinguishing character from those of *Crangon*. The branchial appendages, however, exhibit differences of more importance. In *Crangon* the first pair of gnathopoda carries a small and almost rudimentary mastigobranchial plate, whereas in *Pontocaris* there is a small podobranchial plume attached to the mastigobranchia. On the second pair of gnathopoda I cannot find the rudiment of the mastigobranchial plate, and the arthrobranchiæ are also wanting, but are represented by a pleurobranchial plume.

All the other plumes are pleurobranchial. The branchial arrangement is expressed in the following table:—

Pleurobranchiæ,	...	1	1	1	1	1	1
Arthrobranchiæ,	...	...	...	...	...	...	...
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	1	...	...	...	...	...	...
	h	i	k	l	m	n	o

In this genus the inferior extremity of each branchial plume is thrown forwards (Pl. LXXXVI. fig. 5), and not backwards as in *Crangon* (Pl. LXXXVI. fig. 2) and *Pontophilus* (Pl. LXXXVII. fig. 3).

I only know of two species of this genus, and these are both from the south of New Guinea.

Pontocaris propensalata, n. sp. (Pl. XC. figs. 2, 3; Pl. LXXXV. fig. 5).

Carapace narrower anteriorly than posteriorly; furnished with five longitudinal carinæ, the three dorsal being multidenticulate and converging anteriorly; the lateral are also multidenticulate, the three anterior teeth being very large and culminating in the frontal alæ. Another longitudinal ridge, smooth but not keel-shaped, traverses the infra-lateral wall of the carapace. Rostrum short and pointed, not extending beyond the extremity of the ophthalmopoda. Fronto-lateral margin considerably produced anteriorly. Dorsal surface of the pleon interruptedly carinated in the median line, and corrugated laterally in oblique ridges.

Ophthalmopoda small.

First pair of antennæ short.

Second pair of antennæ having a subcircular or discoid scaphocerite; flagellum a little longer than the carapace.

Telson long, sharp and smooth.

Length, entire (female),	34 mm (1·3 in.).
„ of carapace,	11 „
„ of rostrum,	1 „
Breadth of carapace,	8 „
Length of pleon,	23 „
„ of third somite of pleon,	4 „
„ of sixth somite of pleon,	4 „
„ of telson,	7 „
„ of scaphocerite,	4 „
„ of first pereiopod,	13 „
„ of second pereiopod,	9 „
„ of third pereiopod,	18 „
„ of fifth pereiopod,	14 „

Habitat.—Station 192, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; off the Ki Islands, south of Papua; depth, 140 fathoms; bottom, blue mud. One specimen, male. Trawled. Associated with *Philonicus lucasii* and *Plesionika rostri-crescentis.*

The carapace is furnished with five distinct carinæ, which are armed with strong, pointed, but not very sharp, denticulate processes. There is one on the dorsal median line and one on each side, corresponding to the line of separation between the branchial and visceral regions; these three gradually converge anteriorly towards the rostrum. One on each side passes forwards from the posterior margin of the carapace and terminates in the outer fronto-lateral angle; these carinæ are continuous, except where they are interrupted by the cervical suture, and on them the teeth are larger anteriorly; there being two large and a small one anterior to the cervical suture, and posterior to it there is one larger, the rest gradually decreasing in size and prominence to the posterior margin.

The pleon is furnished with an interrupted, median, dorsal carina.

The first somite has two prominent longitudinal ridges, one on each side of the median line. The second has a median ridge projecting anteriorly in the form of a tooth, and on each side a slightly waved linear prominence that is lost in the posterior margin near the union of the coxal plate with the somite. The third somite has the median ridge more elevated than on the preceding one, and the lateral ridge, which commences at the anterior margin in close approximation to the median carina, gradually diverges posteriorly in a waved line until it reaches the posterior margin, where it is lost. The fourth somite has a median carina posteriorly terminating in a slight point, and flanked by two oblique ridges that terminate in the posterior margin. The fifth somite differs markedly from the anterior four; it has no central carina, but a strong longitudinal ridge on each side, slightly diverging posteriorly and projecting a little beyond the posterior margin, and on its lateral wall there are also two less important longitudinal ridges.

The sixth somite is also without a median carina, and the two lateral ridges are broken into small cusps; a little outside of the terminal extremity of which, a sharp tooth projects backwards from the posterior margin.

The telson is dorsally flat, long, narrow and smooth, having on each side a longitudinal ridge that gradually converge to a point.

On the ventral surface of the pereion (fig. 3), the fifth, sixth and seventh somites are centrally carinated, the carina on the fifth being anteriorly produced to a sharp tooth between the third pair of pereiopoda.

The five anterior somites of the pleon are each armed in the ventral median line with a long, laterally compressed tooth, of which the anterior is the longest and sharpest,

each gradually becoming less prominent until in the fifth it exists as a thin, pointless plate.

The ophthalmopoda are rather small and round, and rest in a concave depression in the upper surface of the first pair of antennæ, where they are protected by a thin stylocerite.

The first pair of antennæ (fig. 2*b*) is short, the extremity of the peduncle reaching scarcely beyond the level of the fronto-lateral angle of the carapace. The first or coxal joint is furnished on the outer side with a sharply pointed stylocerite, the inner margin of which is fringed with fine cilia, while a fasciculus of a few long hairs springs from the surface, and surrounds the eye; the second joint is longer than the first and is produced to a point at the outer distal angle; the third is shorter than the second, and is armed with a short tooth on the outer margin. The flagella are unequal; the outer or primary, which is scarcely twice as long as the peduncle, is very robust, flattened, rapidly tapers to a fine extremity, and is abundantly furnished with membranous cilia. The inner or secondary flagellum is more slender and longer than the primary, and fringed with numerous simple hairs.

The second pair of antennæ (fig. 2*c*) has the last joint of the peduncle long and the other joints short; the scaphocerite, which is almost circular, being as broad as long, is furnished with a small tooth on the distal extremity of the outer margin; the inner margin is fringed with long hairs, and the distal surface minutely pilose. The flagellum is about half the length of the animal and is thickly studded with minute, short, stiff, curved spinules.

The second pair of gnathopoda (fig. 2*i*) is long, slender and four-jointed, reaching beyond the extremity of the first pair of antennæ, and carries a short biarticulate basecphysis.

The first pair of pereiopoda (figs. 2*k*, 2*k''*) is long and robust and approximates in form to that of *Crangon vulgaris*. The anterior margin of the propodos (fig. 2*k''*) is more oblique than in *Crangon*, the incisive margin being thin, smooth, and fringed with hairs at its base; the dactylos is sickle-shaped. The second pair of pereiopoda (fig. 3, *l*) is shorter, being about two-thirds the length of the first; it is chelate and the fingers of the chela impinge only at their apices. The third pair of pereiopoda (fig. 3, *m*) is styliform, slender, and twice the length of the second, reaching beyond the extremity of the first.

The first pair of pleopoda (fig. 2*p*) has the rami unequal and foliaceous, and the margins fringed with hairs; the others (fig. 2*q*) have the rami equal and foliaceous, and carry a single stylamblys on the inner margin.

The posterior pair of pleopoda, forming the outer plates of the rhipidura, is long and narrow, but scarcely so long as the telson; the outer branch is armed with a small tooth on the outer distal extremity but has no diæresis; and the inner margin is fringed with hairs.

Pontocaris pennata, n. sp. (Pl. XCI.).

Carapace broader anteriorly than posteriorly; frontal antennal margin obliquely extended outwards and forwards; dorsal and lateral surfaces longitudinally traversed by seven carinæ, of which the three dorsal are multidenticulate and converge anteriorly, the supra-lateral denticulate anteriorly, and the infra-lateral smooth.

The rostrum usually two-pointed, or bifurcate.

There is no tooth on the ventral surface of the pereion between the third pair of pereiopoda.

Telson long and slender.

Length, entire (female),	24	mm. (1 in.)
„ of carapace,	7	„
„ of rostrum,	0·7	„
Breadth of carapace between hepatic teeth,	6	„
„ of frontal angles,	6	„
Length of pleon,	17	„
„ of third somite of pleon,	3·5	„
„ of sixth somite of pleon,	3	„
„ of telson,	5	„
„ of scaphocerite,	2	„
„ of first pereiopod,	10	„
„ of second pereiopod,	6	„
„ of third pereiopod,	14	„
„ of fifth pereiopod,	11	„

Habitat.—Station 190, September 12, 1874; lat. 8° 56′ S., long. 136° 5′ E.; Arafura Sea, south of Papua; depth, 49 fathoms; bottom, green mud. Three specimens; two females, one male. Trawled.

The rostrum is short, bidentate at the apex, and supported by a small tooth on each side at its base. The carapace is traversed longitudinally by seven carinæ. The median carina commences on the gastric region, or a short distance behind the rostrum, and is armed with a row of eight bead-like cusps continuing to the posterior margin. The second, or the first on each side of the median carina, is slightly curved outwards; it commences immediately behind the orbit, and extends to the posterior margin of the carapace, and supports nine small teeth, the four anterior being a little longer than the five posterior. The next or third carina forms on each side the dorso-lateral angle of the carapace, and commences in a large, obliquely directed, wing-like process on the outer side of the orbit, behind which are two small pointed teeth which are separated by a notch from other two behind, whence the carina runs as a smooth ridge to the posterior margin of the carapace. Beneath this, on each side on the infra-lateral surface, is the fourth carina, which commences in a tooth just beneath the outer orbital angle, it is

smooth, and runs continuously to the posterior margin, where it unites with the infra-lateral angle of the carapace, except where it is interrupted by a very small tooth opposite the penultimate somite of the pereion.

The pleon has the lateral margins of the five anterior somites produced to an angle.

The first somite is dorsally armed on the anterior margin with two anteriorly directed cusps, one on each side of the median line, which is smooth, outside which are two others, less regular in form; the posterior margin is tolerably smooth. The second somite is armed with a strong, pointed, anteriorly directed, central tooth, which produces a carina in the median line for half the length of the somite; it is transversely divided by a groove, posterior to which the somite is smooth, the lateral surface only being broken up on each side into two anterior and posterior cusps. The third somite is carinated throughout its entire length, the transverse groove or sulcus terminating on each side close to the central carina; the lateral surface is divided into small cusp-like elevations. The fourth somite is carinated throughout its entire length, the transverse sulcus terminating at the central carina, from near the middle of which a lateral carina runs obliquely to the posterior margin. The fifth somite has no central carina, but one on each side runs obliquely backwards and outwards from near the anterior to the postero-lateral margin, and each is interrupted so as to form a sharp tooth near its centre. The sixth somite has no central carina but a longitudinal groove or depression, chiefly due to the lateral elevation which forms a longitudinal carina on each side, which is armed by three sharp teeth in a line; the postero-lateral angle is produced into a strong tooth on each side.

Each of the five anterior somites is produced laterally to an obtuse angle which is bossed on the outer surface. The sixth somite differs from the others in having the posterior angle pointed and directed backwards, and the lateral angle is also sharper than in the preceding somites, and situated more posteriorly, while the boss or tubercle, instead of immediately surmounting the angle, is situated near the frontal margin.

The telson is long, narrow, acuminate and dorsally flattened, and the lateral margins are abruptly depressed.

The ophthalmopoda are short, large, round, and project but slightly beyond the rostrum. The first pair of antennæ is short; the first joint, the outer distal angle of which projects into a sharp tooth, reaches but little beyond the extremity of the ophthalmopoda. It is concave on the upper surface for the reception of the ophthalmopoda, and carries on the outer side, attached to the base, a stiff and pointed stylocerite, the apex of which reaches nearly as far as the distal extremity of the joint; a fasciculus of long cilia is implanted within the margin, and from its position and form is apparently adapted for sweeping the surface of the ophthalmus and protecting it from external injury. The second joint is short, scarcely as long as the anterior margin is broad, and is distally produced externally to a sharp point or tooth. The third joint is

still shorter than the second, and carries two subequal flagella, neither of which is quite as long as the peduncle. In the male the outer branch is more robust and stronger than the inner, while in the female they closely correspond in size and appearance.

The second pair of antennæ has the scaphocerite broad and short, with the margins subparallel, and reaching but very little beyond the extremity of the ultimate joint of the peduncle of the first pair; the external margin terminates in a sharp tooth, beyond the extremity of which the internal or foliaceous portion extends a little, and is fringed with long cilia. The flagellum is slender and about half the length of the animal.

The mandible (*d*) is slightly curved, cylindrical, and terminates at the molar process (*d'*, *d''*) in two sharp, fork-like points, supplemented with a cutting tooth. The organ is not implanted deeply in the surrounding structure by an apophysis, but attached to muscle tendons at the extremity.

The first pair of gnathopoda (*h*) is short and subpediform; it is five-jointed and scarcely as long as the secondary ramus or basecphysis; the whole organ is richly adorned with long cilia.

The second pair of gnathopoda (*i*) is four-jointed. The first joint or coxa is short; the second, which probably consists of the basis, ischium and meros united, is long, slightly excavate on the inner side near the base, corresponding with the oral aperture, and on the outer side supports an ecphysis scarcely half the length of the joint to which it is attached; the third joint is more slender than the preceding, and about one-third its length; the fifth is more slender than the third, and slightly longer.

The first pair of pereiopoda (*k*) has the anterior margin of the palm (*k'*) oblique, waved, and separated from the short pollex by a deep notch, in which the extremity of the dactylos rests when closed. The second pair of pereiopoda (*l*) scarcely reaches beyond the carpos of the first, it is slender and terminates in a small chela, the fingers of which are gaping and nearly as long as the propodos; the carpos is uniarticulate, longer and more slender than the propodos, while the meros is about the same length. The third pair of pereiopoda (*m*) is long and slender, reaching considerably beyond the distal extremity of the first, and beyond that of the second pair of gnathopoda or either flagellum of the first antennæ; the dactylos is styliform, long, slender, straight, cylindrical and pointed; the propodos is cylindrical, very little if at all longer than the dactylos, and scarcely more robust; the carpos is subequal in length to the propodos and slightly stouter; the meros and ischium are subequal in length, the latter being the more robust; the basis is short, and the coxa is long and tolerably large. There is no tooth nor rudiment of one on the ventral surface of the somite between this pair of appendages. The fourth and fifth pairs of pereiopoda are similar to each other. They are shorter and more robust than either of the preceding, and terminate in a long, slightly curved, flattened and pointed dactylos. Posterior to the coxa on the ventral surface of the last somite of the pereion is a strong calcified plate.

The pleon is long and gradually narrows posteriorly; a strong tooth stands in the median line on the ventral surface of each of the five anterior somites (see fig. 2), gradually diminishing in size from the first, where it is long and strong, to the fifth, where it is little more than a sharp prominence, while there is no trace of it on the sixth.

The pleopoda are short and articulate with the fixed coxal process of each somite near the lateral extremity. The first pair (*p*) has two unequal rami, one branch being as long as the basal joint, and the other about half its length, the inner being destitute of hairs. The second (*q*) and three following pairs are similar to each other, and consist of two subequal foliaceous branches fringed with long hairs, and bearing a small stylamblys on the inner branch.

The ultimate pair helps to form the rhipidura and is implanted beneath the telson, and when compressed the appendages impinge longitudinally against each other in the median line. The outer plate is the shorter, and terminates subapically on the outer side in a small tooth; the inner plate is more tapering and reaches as far as the extremity of the telson.

Observations.—This species may easily be distinguished from *Pontocaris propensalata* by the extension of the fronto-lateral wing-like processes in an obliquely outward direction, instead of directly forwards.

The carapace has the same number of carinæ, similarly situated, but the infero-lateral ridge is more decided in character. The rostrum is bifurcate at the extremity in the described specimen, which is a female. There are two others in the collection that closely resemble the type; one has the rostrum rounded as if the two apical points had been rubbed down, the third, which I take to be a male, is somewhat more slender in form, less corrugated generally, and has the outer ramus of the first pair of antennæ much more robust; in this specimen the rostrum is sharp pointed and the teeth at the base are obsolete. The posterior margin of the carapace is more compressed than the anterior, and the lateral carina has only two rudimentary denticles posterior to the three or four large ones at the anterior extremity. The dorsal carina on the pleon is interrupted, and the corrugations are as prominent as those of the preceding species, but slightly different in form. The ophthalmopoda are larger, but the oral appendages and pereiopoda are very similar. The large tooth on the ventral surface of the pereion in *Pontocaris propensalata* is wanting in *Pontocaris pennata*, but in both species laterally compressed teeth are present on the ventral surface of the pleon. The general character of the integumentary structure is strong and rigid, much more so than we find in any of the species of the genus *Crangon*, and corresponds more with that of the genus *Glyphocrangon*, from which, however, it differs in several essential points of structure.

Tribe **Polycarpidea.**

This tribe consists of all those normal Phyllobranchiata in which the second pair of pereiopoda is slender, and in which the carpos is divided into a greater or less number of articuli. It includes the families Nikidæ, Alpheidæ, Hippolytidæ and Pandalidæ.

Family Nikidæ.

This family consists of those genera which have the carapace produced anteriorly to a rostrum that is horizontal with the dorsal surface, the mandibles without a psalistoma or synaphipod, the first pair of pereiopoda simple or chelate and stronger than the second pair, which is minutely chelate and has the carpos multiarticulate.

It corresponds nearly with the Lysmatinæ of Dana and Kingsley, but I prefer to consider the genus *Nika*, which Dana places first in his list, as being the type of the family, inasmuch as it exhibits the point of union between the two forms, or those genera which have the first pair of pereiopoda on one side simple and on the other chelate. In *Glyphocrangon* we find that both hands of the first pair are simple, with a flexible dactylos, after the manner of the one on the left side in *Nika*, and in *Lysmata* both are chelate as on the right side in *Nika*.

Glyphocrangon, A. Milne-Edwards.

Glyphocrangon, A. Milne-Edwards, Ann. d. Sci. Nat., sér. 6, tom. xi. p. 3, 1884.
„ Sidney Smith, Rep. "Albatross" Dredgings, 1886.

The external tissue of the species that belong to this genus is hard and rigid, and exhibits a tendency to tuberculose ornamentation; the carapace is subcylindrical, scarcely a third the length of the animal, measured from the frontal margin to the extremity of the telson. Anteriorly it is produced to a strong, rigid, and sharp pointed rostrum, dorsally depressed in the median line. The frontal margin has the orbit broadly but not deeply excavate, and armed on the outer canthus with a large spine-like tooth. There is another of similar character corresponding with the second pair of antennæ, and posteriorly to this, but at a slightly higher level, is another tooth that varies in different species and corresponds with a longitudinal ridge. There are eleven longitudinal ridges, one median and five on each side of it, and these ridges are more or less pronounced in the several species, being most distinct in the less tuberculose forms. The median ridge exists only on the rostrum and frontal region as a minute line of elevation, terminating in a transverse groove that separates the frontal from the gastric regions; one on each side of the median, commencing at this groove, traverses the carapace to the posterior margin; on the outer side is another ridge, more conspicuous behind the

cervical fossa than anterior to it; beyond this is another that appears to commence in the hepatic tooth, which varies in importance in different species, and continues to the posterior margin of the carapace; a fourth ridge on each side commences in the post-antennal tooth, is interrupted at the cervical fossa, and then continued to the posterior margin of the carapace; again, beyond this, is another ridge that is generally less conspicuous, and sometimes appears to divide and traverse the carapace from the anterior to the posterior margin, whilst a strong submarginal ridge, commencing at the antennal tooth, traverses a line within, corresponding with the margin of the carapace, and continues from the frontal and approaches in the median line at the posterior margin.

The pleon is generally tuberculose even in the smoother forms, the texture of the somites is universally rigid, and the dorsal surface is elevated in the median line into a strong but broken ridge, the anterior extremity of which is produced into an anteriorly projecting cusp which rests in the extended position of the animal on a smooth depression in the carapace. A similarly formed tooth also exists on each side and similarly rests against the carapace in a line corresponding with the second dorsal ridge. The lateral margins are produced to strongly projecting teeth that vary in number and importance, there being only one on the first, two or three on the second, two on the third, fourth, and fifth, and one on the sixth somite. The four anterior somites are united by a small hinge joint, consisting of a small protuberance at the postero-lateral margin, which rests in a corresponding hollow of the anterior margin of the succeeding somite.

The posterior articulations of the three last somites differ from the preceding. The three anterior articulate by a process projecting from the posterior margin, and which rotates in a cup on the anterior margin of the next succeeding somite. The three posterior somites possess a button-shaped protuberance projecting from the anterior margin, which is lodged in a hollow produced by a curved process projecting from the posterior margin of the one preceding.

A slight modification exists in the last somite; the curved process or articulation is more ovate, and the telson has the anterior process implanted within it; so that by a slight contraction of the flexor muscles, the telson is forced into a fixed position, and is only released when these muscles are relaxed.

The telson is a long bayonet-shaped organ; it is transversely quadrate, each angle forming a longitudinal rigid and elevated carina which converges to a sharp point that is slightly curved upwards. It is generally longer than the lateral plates of the rhipidura, which are membranous, soft and flexible. On the anterior portion of the dorsal grove of the telson is a strong cusp that generally underlies the projecting tooth of the sixth somite, which, when the animal is extended, presses against its posterior surface and strengthens it in its position. The telson in this genus is undoubtedly an offensive weapon, and a very powerful one when the animal wills to strike, but should

the intended blow miss its mark, the several dorsal processes in the median line become structurally protective, for the telson when fixed for striking, is supported in position by the tubercle on the dorsal surface being brought into contact with the posterior tooth of the sixth somite, and in the same way support is given by several successive somites until the first is relieved by the pressure of the antero-central tooth against the postero-dorsal surface of the carapace.

The ophthalmopoda are short and support large and globular ophthalmi. On the inner surface near the ophthalmus in some species a small denticular projection is present that I take to be the representative of a phosphorescent organ. The ophthalmopoda rest in an orbit which is defined by a large projecting tooth on the outer canthus.

The first pair of antennæ is short and terminates in two short flagella; the basal joint is hollowed to receive the eye when at rest, and is without a stylocerite.

The second pair of antennæ carries a scaphocerite that is broad and disc-like, the outer margin being as soft and flexible as the inner; it is fringed with fine hairs. The tooth commonly present on the outer margin of this organ is wanting or reduced to a minute denticle, easier felt than seen, and is situated about one-third the length of the organ from the base. This antenna carries a flagellum that nearly equals half the length of the animal.

The mandibles are similar to those in the genus *Crangon*, they carry no psalistoma or synaphipod, and are enclosed within the lips.

The first pair of siagnopoda are small, three-branched, and closely hug the oral walls on each side. The second pair of siagnopoda consists of two branches; the inner, or that nearest the mouth, is small, tapering and two-jointed, the outer is broad and subfoliaceous, and represents the mastigobranchial plate; it is uniarticulate (and therefore not correctly represented on Pl. XCII., *f*), the anterior extremity being rounded and fringed with hairs, as is the posterior extremity, which projects beyond the articulation, the margin being fringed with hairs centrifugally directed, their extremities being curved towards the anterior end.

The third pair of siagnopoda is four-branched, the inner branch is small and rudimentary, the second is flat, pointed, and fringed with hairs; the third is broad, rounded at the extremity, fringed with hairs, and from the inner margin a slender lash-like process projects anteriorly; the fourth represents the mastigobranchial appendage, and consists of a long, narrow, hairless plate directed both anteriorly and posteriorly.

The first pair of gnathopoda is seven-jointed; the second joint or basis carries a long, gradually tapering, lash-like basecphysis fringed with small hairs; the ischium and meros are broad at the base but become narrow towards the distal extremity; the carpos is short and suddenly enlarges, the broader extremity supporting the propodos, which is long, flat, and distally obliquely truncate, the margin bearing a wide and short dactylos.

The second pair of gnathopoda is only five-jointed. The first two joints, the coxa

and basis, articulate with each other, the latter bears a small ecphysis, and the succeeding two, the ischium and meros, are closely impacted or fused together, and can be defined by their line of demarcation rather than by their articulation; the carpos is fused either with the meros or propodos, which latter is broad and articulates with the preceding joint obliquely downwards, and is distally united with the dactylos, which is as wide at its base as the propodos; it is fringed with short, strong, rigid spinules, and terminates in a long, stiff, smooth, and sharp pointed unguis.

The first pair of pereiopoda is a stout and powerful appendage; the coxa and basis are short and articulate freely; the ischium is fused with the meros, but is short and clearly defined; it projects on the inner surface to a large tooth, while the meros is long and subcylindrical; the carpos is short but broader distally than at the meral articulation; the propodos is long and ovate, and articulates with a strong and simple dactylos.

The second pair of pereiopoda is long and slender; the coxa and basis are short, the ischium is long, broad, and flat, being longitudinally concavo-convex; the meros is long, narrow and cylindrical; the carpos is long and multiarticulate; the propodos is short and with a minute dactylos forms a small but perfect chela. The two sides are uniform.

The two following pairs are similar to each other, being long, slender, and cylindrical, and terminate in long, slender, and styliform dactyli. The posterior pair is liable to vary specifically in form.

The first pair of pleopoda is unequally biramose, differing in the male from that in the female in being larger and more robust; the inner branch supports a stunted stylamblys tipped with numerous cincinnuli, while that of the female is narrow and foliaceous. The second pair is alike in both sexes, differing only in the male having two stylamblydes attached to the inner ramus, while there is only one in the female, the ova being attached to the hairs, not of the branches, but of the basal joints only. The other pleopoda resemble the preceding, increasing in size posteriorly to the fourth, the fifth pair being smaller, while the sixth forms the outer plates of the rhipidura, and are broad and foliaceous, rounded at the extremity and shorter than the telson.

The branchiæ (Pl. XCIII. fig. 1) consist of six large pleurobranchial plumes, of which the posterior is the largest, and four arthrobranchiæ, and may be best understood by the following table:—

	h	i	k	l	m	n	o
Pleurobranchiæ,	...	1	1	1	1	1	1
Arthrobranchiæ,	...	1	1	1	1	...	...
Podobranchiæ,	...	...	...	...	...	...	...
Mastigobranchiæ,	...	...	...	...	...	...	...

Development.—I have not found any specimens of the young at any stage, but one of the females of *Glyphocrangon granulosis*, from the north of New Guinea, had numerous large ovate ova that were nearly ripe for extrusion, so that by extracting the embryo

from the egg I was enabled to arrive at an approximate knowledge of the form of the animal when it first leaves the ovum. The brephalos is in the Megalopa stage (Pl. XCII. fig. 4), and closely resembles that of the common lobster (*Homarus vulgaris*).

My examinations took the form of a series of dissections of several ova, but not the observation of one perfect specimen.

Geographical Distribution.—There are several species of this genus, and those in the Challenger collection are from twelve different localities. The earliest specimen was taken on the 9th of September 1873, off the most easterly point of South America, and A. Milne-Edwards and Mr. Sidney Smith have since recorded specimens from the West Indies and the North Atlantic. Specimens have been taken as far south as the Island of Tristan da Cunha in the South Atlantic and near Kerguelen Island in the Indian Ocean. Among the Islands of the Eastern Archipelago specimens have been taken in the shallow water of the Sea of Banda, and in the greater depths north of New Guinea. They have also been taken as far north as Japan and as far west as the Fiji and Kermadec Islands; in the Pacific others have been taken some few miles south-west of Juan Fernandez, where they were found associated with species of Eryonidæ. Some were taken along with *Polycheles* off the north of New Guinea, and others off the Fiji Islands, also associated with *Polycheles*, in depths varying from 200 to 1715 fathoms.

The various forms of this genus can scarcely be considered as being more than varieties of one great type; the specific differences being little else than a greater or less exaggeration of features common to them all.

Glyphocrangon granulosis, n. sp. (Pl. XCII.; Pl. XCIII. fig. 1).

Rostrum sharp pointed, subequal in length with the peduncle of the first pair of antennæ, armed with a sharp and strong tooth on each side near the middle, and another at the base, which in the female is supplemented by another smaller one posterior to it. Still more posteriorly, upon the dorsal surface of the carapace and standing on the same ridge which is formed by the continuation of the lateral margin of the rostrum, is a broad, flat, and pointed tooth directed upwards and forwards. The fronto-lateral margin is armed with two large teeth, of which the one external to the ophthalmopod corresponds with the external orbital angle, and the other forms the infero-anterior angle of the carapace; behind the latter stands a smaller but still large, flat tooth which forms the anterior extremity of a ridge. There are five such ridges longitudinally traversing the carapace on each side of the median line, most of them being armed with a series of points or teeth, while the intermediate spaces are covered with strong granulations disposed generally in a longitudinal direction. The posterior margin of the carapace is depressed, smooth, and laterally projecting posteriorly, and is overridden by the anterior margin of the coxal plate of the first somite of the pleon.

The pleon is furnished with a strong dorsal ridge that runs down the median line in an interrupted manner, breaking up on each somite and each division of the somite into a longitudinal cusp. The first somite has a central cusp which traverses only the first half of it, and is elevated into a strong laterally compressed tooth, that has its point directed forwards. On each side there is another large laterally compressed cusp that is directed upwards and outwards but does not override the anterior margin of the carapace. The median ridge, which on each succeeding somite is interrupted in the centre by a transverse furrow, is most marked and projecting on the posterior extremity of the fourth somite.

On the fifth somite the median ridge is also present, but it is here a less important feature, and the transverse sulcus is also less conspicuous and divides the carina into an anterior and a posterior portion; the anterior commences at the anterior margin and ends at the sulcus, and is laterally supported by an obliquely placed cusp; the posterior begins at this sulcus and continues on each side obliquely backwards and outwards to the posterior margin of the somite, having a cusp between these.

The sixth somite has the median ridge well developed, divided at the middle, and projecting posteriorly into a sharp tooth that overhangs the telson.

The lateral walls, or coxal plates attached to the several somites of the pleon, are inferiorly and posteriorly produced to a strong tooth, excepting in the case of the first, which, when the pleon is flexed on the pereion, is covered by that of the second somite. The whole surface is coarsely granulated.

The telson is sharp pointed and dorsally grooved; at the anterior extremity of this groove the median dorsal carina is represented by a small tooth, on each side of which a strong slightly serrate ridge traverses the upper surface and meet at the pointed extremity; from the ridge the lateral walls are perpendicular.

Length, entire,	103	mm. (4 in.).
„ of carapace,	31	„
„ of rostrum,	18	„
Width of carapace,	23	„
Length of pleon,	72	„
„ of third somite of pleon,	10	„
„ of sixth somite of pleon,	11	„
„ of telson,	23	„
„ of scaphocerite,	15	„
„ of first pereiopod,	39	„
„ of second pereiopod,	35	„
„ of fifth pereiopod,	48	„

Habitat.—Station 218, March 1, 1874; lat. 2° 33′ S., long. 144° 4′ E.; between New Guinea and Admiralty Islands; depth, 1070 fathoms; bottom, blue mud; bottom temperature, 36°·4. Two specimens; one male, one female. Trawled.

The rostrum of this species is slightly turned upwards at the extremity and is armed on each side with two strong teeth, one near the middle and another at the base, above the inner canthus of the orbit, and there is a third still more posterior; all stand on an elevated ridge continuous with the lateral margins of the rostrum, and passing back separates the orbital regions from the gastric.

On the frontal margin, external to and forming the outer angle of the orbit, is a large, obliquely situated, triangular tooth pointing upwards and forwards, and there is another just within the fronto-lateral angle of the carapace where it suddenly turns towards the oral region, producing a prominent fold or process between the first and second pairs of gnathopoda, from the base of which a strong ridge runs backwards and downwards and unites with the lateral margin just behind the second pair of gnathopoda.

The visceral regions are well defined on the carapace by a ridge and depression between the gastric and the frontal region; by a depression between the gastric and cardiac, and by a longitudinal ridge formed of strong cusps between the cardiac and branchial regions.

There are five longitudinal ridges that traverse the carapace on each side of the median line, interrupted only by the lines of regional demarcation. The most lateral in this species is the most continuous; it commences at the fronto-lateral tooth, from which it is divided by the fronto-lateral depression, it then forms two long pointed narrow cusps, and is again interrupted by the latero-branchial depression, after which it is continuous nearly to the posterior margin. The next commences in a strong cusp at the branchio-gastric depression, and is continuous in the form of a long narrow ridge of tubercles to the posterior margin. The next commences in a strong tooth posterior to the orbital region, and is represented by five teeth anterior to the cervical fossa, of which the anterior is the largest and the posterior the smallest, and posterior to the cervical suture is continued in the form of six or seven long narrow cusps to the posterior margin of the carapace. Although this ridge is only definable as such posterior to the cervical suture, yet it is continuous with that formed by the lateral margins of the rostrum; departing from a straight line it passes inwards to unite with it anteriorly, and posteriorly it breaks up into several strong teeth connected with the ridge that runs to the posterior margin of the carapace.

The next or dorsal ridge runs one on each side of the median line, and traverses the carapace from the anterior extremity of the gastric region to the posterior margin of the carapace, in the form of a row of sharp narrow cusps, being interrupted only by the cervical suture. Along the median line of the rostrum there is a small thread-like line of elevation, while the median line as a whole appears to be depressed; this however is due rather to the absence of tubercles than to an actual lowering of the surface. Between the several ridges the carapace is covered with a number of small, pointed granulations, running in more or less perfect, longitudinal rows. The only portions of the carapace that are free

from these coarse granulations are immediately behind the eyes, the fronto-lateral margin, the dorsal surface of the rostrum, and the median line.

The somites of the pleon are also coarsely granulated, but the granulations do not run longitudinally except along the median ridge, where every somite has an anterior and a posterior cusped elevation on the exposed portion, more or less prominent continuously to the telson. All the somites exhibit three divisions, an anterior, a median, and a posterior. The anterior is perfectly smooth, and when the animal is extended, as in swimming, it is always covered by the posterior margin of the preceding somite. In the first somite the anterior division passes under the carapace, and a fringe of hair along the anterior margin of the central division assists in closing up the line of junction between it and the carapace. The median division is separated from the posterior by a line of depression, which is again divided into three parts, a central and two lateral, each of which is furnished with a strong pointed cusp or tooth. The central cusp is pointed directly forwards, the lateral obliquely outwards. The coxal plate is produced as deeply as the carapace, which is covered by the anterior margin of the coxal plate, while the posterior is overridden by the next succeeding somite. The postero-inferior angle is rounded off and the anterior is produced to a sharp point. The second somite is longer than the first, and the coxal plate is wider and slightly deeper, and has the margin produced into three sharp teeth, one at the anterior angle, one, the largest, central, and one at the posterior angle. The third somite resembles the second in all but the presence of a tooth at the antero-inferior angle. The fourth somite has the dorsal surface of the posterior division produced posteriorly to an obtuse angle, and the coxal plates resemble those of the third. The fifth differs from the fourth in being narrower, in having the posterior cusps on the median line flanked at the base by two oblique ones, and in having the coxal plate directed inferiorly backwards, the tooth at the posterior angle being the largest. The sixth somite has the coxal plate reduced to a single tooth-like process, between which and the posterior margin the posterior pair of pleopoda articulates.

The telson, besides the central cusp on the anterior portion, has a couple of continuous ridges running longitudinally, well defined, and converging to the extremity of the telson, giving to this somite a fluted appearance.

The three anterior somites of the pleon articulate laterally with those posterior to them by a small prominence on the posterior margin, fitting into a hollow in the anterior margin of the succeeding somite, and the posterior three and telson by a process on the anterior margin being enclosed within a space which is formed by a flat process projecting backwards and upwards, and pressing laterally against the somite posterior to it.

The ophthalmopoda are supported on a free ophthalmic somite implanted immediately beneath the rostrum. The peduncle is extremely small and short, while the ophthalmus is very large and conspicuous, being almost globular, and occupying nearly the entire space between the rostrum and the orbital tooth.

The first pair of antennæ (Pl. XCII. *b* ♂ *b* ♀) has the peduncle extending to the extremity of the rostrum in the male, and a little beyond it in the female. The first joint reaches beyond the anterior margin of the eye, and is excavate in its entire length to receive that organ; near its base it is lobed on the inner side, where the acoustic organ is situated, the opening of which is on the lower external surface, beneath a squamiform process or plate (*b*″ ♀). The second joint is about half the length of the first and subcylindrical. The third is shorter than the second and terminates obliquely, the inner angle, which is the more advanced, supports the inner, shorter, and less important flagellum, the outer angle, which is broad and oblique, supports the primary or more important flagellum, which in the male is thicker than in the female. It is formed by a large number of short articuli that are broad at the base and for about half the length of the appendage, and then rapidly diminish as the flagellum gradually narrows to a slender lash. The upper side of the thicker portion is flattened, while the lower is rounded and supplied with numerous fine membranous cilia which are more numerous in the male than in the female.

The second pair of antennæ (*c* ♀) has a peduncle that does not reach beyond the extremity of the second joint of the peduncle of the upper. The coxa or first joint is very short and supports a prominent phymacerite on the inner side, the second is broad and at its outer angle supports a large oval scaphocerite, which thins out on each side from the central line, and is fringed all round with long cilia. The outer margin is rigid, and the tooth which is so universally prominent in the Macrura is reduced to a rudimentary condition, so as to be invisible to the unassisted eye, but a rigid margin is traceable for some way from the base. The third and fourth joints are oblique to each other and both articulate with the second at the antero-internal margin; the fifth joint is narrow, cylindrical, and as long as the four preceding.

The mandibles (*d*) are small and consist of a molar process only, and are enclosed deeply within the oral cavity so that they are entirely covered over by the cheiloglossa and metastoma.

The first pair of siagnopoda (*e*) is small, lying closely pressed against the posterior surface of the metastoma; it consists of three branches, the central of which is fringed with stiff hairs.

The second pair of siagnopoda (*f*) consists of a rudimentary one-jointed appendage, supplemented by a broad, thick, fleshy plate, which bears a thick fringe of hairs, centrifugally planted on its margin.

The third pair of siagnopoda (*g*) consists of two foliaceous plates, the outer of which supports a lash-like appendage, and a thick, fleshy, smooth margined plate that tapers and projects anteriorly as well as posteriorly.

The first pair of gnathopoda (*h*) is short, subpediform, and consists of seven joints. The coxa and basis are subequally short and wide; from the latter a long, slender, lash-

like ecphysis arises, which gradually tapers to the extremity; it is hirsute, more especially near the base; the ischium is also short and broad; the meros is longer and tapers slightly towards the distal extremity, where it articulates with the carpos, which is short, narrow at the base, and broad at its distal margin, where it articulates with the propodos; the latter is long and ovate, to receive the dactylos, which is short and broad and fills up the deficiency in the ovate form of the propodos. The distal margin of the dactylos and the outer margin of the propodos are thickly fringed with stiff hairs interspersed with strong spines.

The second pair of gnathopoda (*i*) is long, robust, and pediform, it consists of only four distinct joints, the homologues of which are difficult to determine, but naming those that remain according to their relative position in the limb, the coxa and the basis are short, the latter, the ischium and meros are united into one long joint, which is concave below and excavate on the upper surface to allow space for the several preceding appendages that surround the mouth, and supports a slender and lash-like ecphysis, which articulates immediately beyond the coxal articulation. The next joint, which may be the carpos, articulates at a considerably oblique angle with the preceding; it increases in size slightly towards the distal extremity. The upper surface is transversely rounded, the lower excavate, and the internal perpendicular, the two latter being thickly matted with short hairs; the outer margin is fringed with few hairs and some large strong spines. The terminal joint resembles the dactylos of a true pediform appendage, and is probably the propodos and dactylos united and compressed; it gradually tapers to the unguiculated sharp pointed extremity. The inner, under, and outer sides are studded with strong spines that articulate in thick marginal sockets.

The first pair of pereiopoda (*k*) is robust but not very long, being only subequal to the second pair of gnathopoda. The coxa is short and broad; the basis is short and firmly fused with the ischium, which is anteriorly produced on the inner side to a strong sharp process or tooth, the outer side is oblique and articulates for nearly its entire length with the base of the meros, with which it has but little free movement and that only in one direction; the meros is long and slightly tapering to the distal extremity; the carpos articulates at the extremity of the meros, and bends suddenly at a right angle; the propodos is ovate, gradually narrowing to the distal extremity, where it articulates with a sharp pointed, curved, cylindrical dactylos, which, when closed, impinges against the under, slightly flattened, surface of the propodos. The under and upper margins of the palm of the propodos are defined by several fasciculi of short hairs.

The second pair of pereiopoda (*l*) is long, slender and feeble. The coxa and basis are short; the ischium is long and traversed on the lower and inner side by a deep thin ridge, thus providing on the upper surface a concave space in which the distal extremity of the reflexed carpos lies protected when folded and at rest; the meros is as long as the ischium, and cylindrical; the carpos is as long as the ischium and meros together and multi-

articulate; the propodos is very short and scarcely broader than the carpos, the inferior distal angle is produced to a sharp polliciform process, against which the small sharp dactylos impinges obliquely.

The three posterior pairs of pereiopoda are strong, slender, well-formed, simple appendages. The coxa is short and large, the basis short and narrow and with the outer side oblique, and it articulates with the ischium, which is moderately long and slender, and has the distal extremity oblique and articulating with a long slender meros, the extremity of which slightly increases in size and articulates with the carpos, which just beyond the joint suddenly curves at nearly a right angle; it is about half the length of the meros and cylindrical; the propodos is cylindrical, one-third longer than the meros, and distally furnished with hairs, amidst which a cylindrical dactylos articulates and terminates in a narrow, sharp pointed unguis.

The first pair of pleopoda (♂ *p* ♀) articulates with the coxal plate on the inner side, nearly at the extremity, opposite to an external boss or large tubercle; the basis is long, pedicular, and supports two foliaceous plates, of which the inner and posterior is the smaller and carries attached to the inner margin a small stylamblys, furnished towards the extremity with small, obtusely pointed cincinnuli. The four following pairs of pleopoda (♂ *q* ♀) are formed upon the same type as the first, but the foliaceous branches are larger and the inner one in the male supports two of the small stylamblydes, one of which is fringed with hairs.

The posterior pair of pleopoda, which helps to form the rhipidura, has the basal joint short and the foliaceous plates long. The inner plate is pointed and fringed with hairs, the outer rounded, having a diæresis near the external marginal tooth, from which point it is fringed with hairs along the distal and inner margins.

The telson is long, narrow, and tapering; it is rudely quadrate in transverse section at the anterior extremity, and cylindrical at the apex; the angles are longitudinally ridged, those on the upper margin being slightly serrate, and the dorsal surface is depressed or grooved but furnished in front with a strong pointed cusp in the median line, which represents the terminal continuation of the dorsal carina of the pleon, with which, when the animal is extended, it is in close apposition.

The animal during life has the power of locking the telson in a fixed position, when undoubtedly it becomes a very powerful weapon of offence, and again unlocking it at its own will. The male and female closely resemble one another, but the female is larger than the male; all the parts in the two sexes have a similar proportional relation except such as may be supposed to be sexually variable.

The first pair of antennæ in the male has the external or primary flagellum broader and more thickly studded with membranous cilia; like the ophthalmopoda these antennæ stand upon a rudimentary ventral arc of the first somite. The acoustic organs appear to be internally well developed and occupy a chamber in the first joint. The upper surface

is excavated for the reception of the large visual organs, and centrally the structure of the integument is reduced to considerable tenuity, through which a longitudinal fissure, like a closed aperture, exists. At the base of the joint on the inner side there is a considerable hollow enlargement with a narrow aperture on the inferior surface, which is protected by a strong but not very prominent ridge. At the opposite extremity of the same joint there is a thin semi-membranous spot that is also probably associated with the acoustic apparatus.

The second pair of antennæ appears to spring from the metope or facial wall, which in both sexes is membranous. The phymacerite exists in the form of a conspicuous tubercle, flattened transversely, the opening of which is on the posterior surface close to and at the end of a long groove in the lateral wall, which is larger and more conspicuous in the female than in the male.

The cheiloglossa is continuous with the epistoma, which in the male is membranous and perpendicular. The metastoma consists of two plates separate from each other longitudinally and obliquely, and produced anteriorly and laterally in the form of large fleshy plates, that cover not only the oral opening but overlap to a considerable extent the posterior lateral margin of the cheiloglossa, so as to cover up and entirely hide the mandibles in the male. In the female the mandibles are seen at the side apparently thrown very far back. In the two sexes the conditions are different, the epistoma in the female is strong and calcified, and the cheiloglossa projects conspicuously beyond its margin, and anteriorly presses between the mandibles. Hence these latter organs appear to have no external biting power. They lie protected between the lateral margins of the anterior and posterior labra, where apparently they have no power to act until the projecting cheiloglossa, which intrudes itself between them, moves from its position, and acting as a tongue, guides the food to its place both for mastication and deglutition.

The third or middle pair of pereiopoda in the female carries the oviduct, which is surrounded by a fringe of hairs. The fifth or posterior pair in the male carries the penis, the passage of which is by a large round foramen. Behind this last pair of legs a prominent projection like a broad flat tooth, more decided in the male than in the female, rises from the posterior angle of the ultimate somite of the pereion and rests against the inflected margin of the carapace.

The anterior pair of pleopoda differs in the two sexes. In both they are large, foliaceous, and unequal. In the female there is nothing but their size to distinguish them, while in the male the internal branch is more delicate in structure, broader, and carries a short, obtuse stylamblys armed with a few cincinnuli. The four following pairs of pleopoda are alike in size and general form, each branch being equally important. In the female the inner one carries a single stylamblys fringed on one side with long hairs, and the male carries two, one fringed with hairs the other tipped with cincinnuli. On all the pleopoda the hairs are abundant, and thickly fringed with long cilia.

The posterior pair of pleopoda is long, reaching almost to the extremity of the long slender telson; the external ramus is strengthened on the outer side by a thick margin which terminates in a sharp tooth, coinciding with the outer extremity of an imperfect diæresis that extends halfway across the plate, and is distant from the extremity about one-fourth the length of the appendage, from which point it is fringed with long ciliated hairs round the extremity and inner margin. The inner ramus is about the same length as the outer, terminates in an obtuse point, and is fringed on both sides with long ciliated hairs.

The female bears about thirty or forty ova, in which the embryo in our type specimen is seen to be approaching the stage of extrusion, a circumstance that enabled me, but with some difficulty, to approximately determine the form of the brephalos.

The ovum is oval in form and supported by a membranous filament attached to the hairs of the basal joint of the pleopoda, none being attached to those on the branches.

The brephalos (Pl. XCII. fig. 4) is very unlike that of the genus *Crangon*, as observed in the typical species *Crangon vulgaris* (Pl. LXXXVI. fig. 4). It approximates more nearly to that which I have seen in *Crangon boreas*, Phipps, and bears a close relation to that of *Homarus vulgaris*, the common European lobster. The brephalos of *Glyphocrangon* is in the Megalopa stage, and the absence of the chelate condition of the pereiopoda is probably due to the early stage at which the embryo was examined, for the young must quit the ovum in a very matured condition, since the vitellus was still large at the period when I had the opportunity of examining it, consequently some time would elapse before the embryo would be mature enough to become independent, but even in this immature condition every appendage is present in a more or less advanced condition.

The ophthalmopoda are spherical, and if not small, are certainly not large; the first pair of antennæ is considerably advanced in growth, terminating in a point, tipped with one or two cilia, and supported by a small pointed lobe which I take to be the extremity of the peduncle. The second pair of antennæ has a large scale-like appendage (the scaphocerite), the sides of which are nearly parallel and the extremity oblique, rising to an obtuse point, and a flagelliform appendage that already reaches beyond the extremity of the scaphocerite.

The oral appendages are apparent, but not easily determinable as to their exact form in this immature condition, until we reach the second and third pairs of siagnopoda, the former of which resembles generally that of the adult, and the latter forms an unequally biramose appendage of the same type as that of the two pairs of gnathopoda next succeeding, which lessen the inequality of their branches as they advance posteriorly. The several pairs of pereiopoda are in an advanced stage of development, and each carries a secondary branch.

The pleopoda are all in an equally advanced condition. The first pair is branched and small. The second and the three following, which are biramose in the adult, have the branches at this stage in a state of gemmation and are scarcely longer than broad. The sixth or posterior pair, which in the adult assists to form the large rhipidura, is further developed than the preceding pleopoda; the two branches are unequal, the outer being much the larger. The terminal somite or telson is broad at the extremity, delicately thin and membranous, and the posterior margin is sparingly fringed with cilia.

Glyphocrangon podager, n. sp. (Pl. XCIII. fig. 2).

Like *Glyphocrangon granulosis*, but having the posterior pair of pereiopoda terminating in a thick cylindrical dactylos that abruptly terminates in two small points.

Length, entire,			63 mm. (2·4 in.).
,, of carapace,			19 ,,
,, of rostrum,			13 ,,
Width of carapace,			13 ,,
Length of pleon,			44 ,,
,, of third somite of pleon,			6 ,,
,, of sixth somite of pleon,			6 ,,
,, of telson,			14 ,,
,, of scaphocerite,			9 ,,
,, of first pereiopod,			15 ,,
,, of second pereiopod	coxa to carpos,	11 mm.	21 ,,
	carpos to dactylos,	10 ,,	
,, of fifth pereiopod,			20 ,,

Habitat.—Station 146, December 29, 1873; lat. 46° 46′ S., long. 45° 31′ E.; near Marion Island; depth, 1375 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·6. One specimen; female. Trawled.

This species very closely approximates to *Glyphocrangon granulosis*, and I should most probably have considered it as belonging to that species but for the peculiar form of the dactylos of the last pair of pereiopoda (fig. 2*o*), which is cylindrical until near the apex, when it suddenly narrows to a blunt end and terminates in two small points.

It further differs in being less tuberculated, more especially between the carinæ on the carapace, where the tuberculations are not prominent, but rather more so than is represented on the plate. The rostrum of the carapace is longer than the peduncle of the first pair of antennæ, while in *Glyphograngon granulosis* it does not reach so far, and it has the lateral margins less tapering than in the latter species, until they suddenly approach each other near the extremity. The ophthalmopoda are also smaller in proportion than in that species; the scaphocerite is as long as the peduncle of the first

pair of antennæ, ovate, and furnished at the middle of the outer margin with a minute denticle. The telson is straight and longer than the lateral plates of the rhipidura. The appendages are generic in character. The carapace has eight longitudinal carina, of which the two dorsal on each side of the median line are denticulated in their entire length, the other two are smooth except for two hepatic teeth on each side close behind the antennal angle. The first somite of the pleon is furnished with three vertically directed tooth-like cusps, the centre one of which is repeated on the anterior and posterior division of each succeeding somite so as to form an interrupted carina that increases in character by losing its denticulation until it reaches the posterior division of the fifth somite, where it is flanked by two obliquely directed ridges, after which it is continued to the posterior extremity of the pleon, where it is produced to a strong pointed cusp. Each somite after the first has the lateral coxal plates deep and armed with two strong teeth, excepting the last, which has only one.

This species was taken in the southern Indian Ocean, halfway between the Cape and Kerguelen Island.

Glyphocrangon regalis, n. sp. (Pl. XCIII. fig. 3, 4).

Carapace one-half the length of the pleon, produced anteriorly to a strong, pointed rostrum about one-half the length of the carapace, having the apex suddenly curved upwards, furnished with a delicate elevated thread-like line down the middle; traceable as far as the gastric region; it is armed on each side with a strong tooth corresponding with the anterior extremity of the opthalmopod, with a second anterior to the frontal region, and a third smaller, posteriorly on the same elevated ridge. Frontal margin broad, armed with two large spine-like teeth, one corresponding with the external canthus of the orbit, the other with the fronto-lateral angle of the carapace, posterior to which, on the hepatic region, is a large laterally compressed tooth. The dorsal surface of the carapace is longitudinally traversed on each side of the median line by four strong ridges. The two dorsal are broken up into long flat tubercles, the two lateral are both smooth and even, and without a tooth-like projection on the anterior extremity; posterior to the cervical fossa, between the several ridges, there are coarse granulations arranged in longitudinal rows.

The pleon has a row of teeth forming an interrupted carina that traverses the median line, commencing on the first somite and terminating in a small tooth on the anterior surface of the telson.

The lateral margins of the coxal plates are armed with two large teeth except the first, which has a small point hidden beneath the succeeding somite, and the sixth, which has only one large tooth directed posteriorly.

Third and fourth pairs of pereiopoda terminating in a cylindrical pointed dactylos,

which in the fifth pair is laterally compressed and lanceolate. Telson having the apex reaching beyond the distal extremity of the lateral plates of the rhipidura.

Length, entire,		90 mm. (3·5 in.).
„ of carapace,		28 „
„ of rostrum,		16 „
Breadth of carapace,		25 „
Length of pleon,		62 „
„ of third somite of pleon,		10 „
„ of sixth somite of pleon,		10 „
„ of telson,		19 „
„ of scaphocerite,		12 „
„ of first pereiopod,		23 „
„ of second pereiopod,	to carpos, 19 mm. / to dactylos, 15 „	34 „
„ of fourth pereiopod,		37 „

Habitat.—Station 194, September 29, 1874; lat. 4° 34′ S., long. 129° 57′ 30″ E.; off Banda Island; depth, 200 fathoms; bottom, volcanic mud. One specimen; female. Dredged.

Station 171, July 15, 1874; lat. 28° 33′ S., long. 177° 50′ W.; north of the Kermadec Islands; depth, 600 fathoms; bottom, hard ground; bottom temperature, 39°·5. Fragment of male. Trawled.

Station 173, July 24, 1874; lat. 19° 9′ 35″ S., long. 179° 41′ 50″ E.; off Matuku Fiji Islands; depth, 315 fathoms; bottom, coral mud. One specimen; female. Dredged.

This species may be distinguished from the preceding by the greater breadth of the anterior portion of the carapace and of the rostrum at its base, and by the presence of a large tooth on the hepatic region immediately posterior to the fronto-lateral tooth. In *Glyphocrangon granulosis* there are two small teeth on the hepatic region, in *Glyphocrangon spinicauda*, A. Milne-Edwards, there are also two, but one is largely produced and laterally dilated.

The branchial region of the carapace is free from tuberculations, and those on the dorsal surface of the carapace are regularly arranged in longitudinal lines, forming conspicuous carinæ; the carinæ on the branchial region are smooth and those on the dorsal surface tuberculated; between these there are other tubercles equally regular but less prominent. In the median line there are none.

The pleon is furnished with a distinct but interrupted carina, of which the moiety on the anterior somite has a strong, central, anteriorly directed tooth, and there is also a similar tooth on each side. The infero-lateral margin of each somite of the pleon is armed with two subequally strong teeth, except in the case of the first and sixth somites,

the former of which has only a point and the latter has also one which is directed outwards and backwards.

The telson is long and very rigid and has a distinctly controllable movement. It is connected with the sixth somite by a peculiar articulation, a small laterally projecting process of the telson being enclosed in a deeply embayed hollow in the posterior margin of the sixth somite; this kind of articulation also exists in the two preceding somites. The movement of these as well as that of the telson is such that by a very slight contraction of the muscles they can be held in a rigid position, and this is undoubtedly voluntary. The power which these animals have of suddenly and rapidly darting backwards makes this sword-like telson a very formidable weapon. Our specimen corresponds in many points with *Glyphocrangon spinicauda*, which Professor A. Milne-Edwards has described as having been taken near the island of St. Kitts at a depth of about 250 fathoms. It may readily be distinguished by the absence of a second tooth on the hepatic region, as also by the absence of a tooth on the branchial region at the anterior extremity of the upper lateral carina, which terminates posteriorly to the cervical fossa.

The female specimen taken at Station 173 varies slightly from the type, but I consider it to belong to this species. It corresponds in all points, excepting that the details are not so well defined, the tuberculation is less conspicuous, the teeth not so strong, and the extremities of the rostrum and of the telson not so decidedly curved; in length it is a little shorter, and there is a minute tooth about one-third the length of the scaphocerite from the base, which is not so conspicuous in the typical specimens.

At Station 171 there was brought up a very broken fragment of a carapace, which, from the stoutness of the outer flagellum of the first pair of antennæ, I take to be that of a male specimen of this species. It is much smaller than the type specimen—judging by the size of the carapace it could scarcely be 50 mm. in length—and it differs from the latter, which is a female, in having the teeth on the frontal margin smaller in proportion to that on the hepatic region.

Glyphocrangon hastacauda, n. sp. (Pl. XCIII. fig. 5).

Carapace slightly tomentose; smooth between the carinæ; all the carinæ smooth except the two dorsal ones, which are imperfectly dentate. Orbital tooth large, flat, long and sharp pointed; tooth on the fronto-lateral angle not so long as the orbital. Hepatic tooth small. The two lateral carinæ on each side terminate anteriorly in a minute denticle just behind the cervical fossa.

Rostrum nearly as long as the carapace, armed with two teeth on each side.

Pleon furnished with an interrupted carinæ in the median line.

Ophthalmopoda orbicular.

Peduncle of the first pair of antennæ scarcely more than half the length of the rostrum.

Second pair of antennæ having the scaphocerite ovate and not longer than the peduncle of the first pair. The other appendages are without important differential characters. Telson longer than the outer rami of the rhipidura.

Length, entire,	64 mm. (2·5 in.).
„ of carapace,	19 „
„ of rostrum,	18 „
Width of carapace,	14 „
Length of pleon,	45 „
„ of third somite of pleon,	8 „
„ of sixth somite of pleon,	7 „
„ of telson,	15 „
„ of scaphocerite,	7 „
„ of first pereiopod,	15 „
„ of second pereiopod,	27 „
„ of fifth pereiopod,	26 „

Habitat.—Station 232, May 12, 1875; lat. 35° 11′ N., long. 139° 28′ E.; *Hyalonema*-ground, off Japan; depth, 345 fathoms; bottom, green mud; bottom temperature, 41°·1. One specimen, female. Trawl and dredge both used.

This species has the surface covered with a short fur, but is otherwise smooth between the several carinæ on the carapace.

The rostrum is long, nearly equal to the length of the carapace, measured from the orbit to the posterior margin. All the carinæ, which comprise the usual number, eight, are free from denticulations except the two dorsal, which show slight indications of denticular marking.

The surface of the pleon is comparatively smooth, but a lateral light on a dry specimen renders markings visible that correspond with the corrugations on other species.

The ophthalmopoda are round and of moderate dimensions.

The first pair of antennæ has the peduncle scarcely more than half the length of the rostrum, but this difference is due to the length of the rostrum rather than to the shortness of the antennæ.

The second pair has the scaphocerite rather ovate than circular, and possesses no trace of a tooth on the outer margin.

The other appendages show no specific character, except that the dactylos of the posterior pair (fig. 5*o*) is long, laterally compressed and lanceolate, the distal extremity of the propodos being furnished with a fringe of long hairs.

The first somite of the pleon has the dorsal surface armed with three long anteriorly directed teeth, the central forms the anterior extremity of the median carina and extends

to the posterior margin of the somite; in all the other species it is interrupted near the centre. The telson is longer than the branches of the rhipidura, and forms a formidable spear-like weapon.

Observation.—This species may be at once recognised by the large orbital tooth.

Glyphocrangon aculeata, A. Milne-Edwards (Pl. XCIV. fig. 1).

Glyphocrangon aculeatum, A. Milne-Edwards, Ann. d. Sci. Nat., sér. 6, tom. xi. p. 5, 1884.

Carapace one-third the length of the animal, ornamented with eight carinæ. Rostrum long, narrow, and about three-fourths the length of the carapace. Antennal and fronto-lateral teeth are large, but not so broad as the hepatic tooth at their base, which is the largest, extending from the cervical fossa to near the frontal margin of the carapace as a great anteriorly pointed ridge. Behind the cervical fossa, at the anterior extremity of the lateral carina, is a strongly projecting tooth of less size than the previous one. The surface of the carapace between the several carina is generally smooth, a few scattered tubercles being slightly indicated.

Length, entire,	62 mm. (2·4 in.).
„ of carapace,	18 „
„ of rostrum,	14 „
Breadth of carapace,	12 „
Length of pleon,	44 „
„ of third somite of pleon,	6 „
„ of sixth somite of pleon,	6 „
„ of telson,	13 „

Habitat.—Station 120, September 9, 1873; lat. 8° 37′ S., long. 34° 28′ W.; off Pernambuco; depth, 675 fathoms; bottom, red mud. One specimen; female. Trawled.

This species was described by Professor A. Milne-Edwards as having been taken in 593 fathoms, off Martinique, during the cruise of the "Blake" in the West Indies. It nearly corresponds with *Glyphocrangon spinicauda*, A. Milne-Edwards, which was taken in 250 fathoms off St. Kitts in the same geographical region. Our specimen, which was taken some degrees further south in the Atlantic, off the eastern coast of South America, is rather smoother than either of the above.

In the Challenger specimen the rostrum is about three-fourths the length of the carapace, and reaches beyond the distal extremity of the peduncle of the first pair of antennæ. The scaphocerite attached to the second pair of antennæ is furnished with a small tooth on the outer margin about halfway between the distal extremity and the articulation. The dactylos of the posterior pair of pereiopoda (fig. 1*o*) is flat and sharply lanceolate.

The pleon has the surface much more tuberculated than the carapace, and more so than the lithographic artist has shown in the plate. The telson is long and well developed, being quite half the length of the pleon.

Glyphocrangon acuminata, n. sp. (Pl. XCIV. figs. 2, 3).

Rostrum nearly as long as the carapace; median carina on the anterior extremity elevated above the lateral margins, extending nearly to the frontal region, and armed on each side with two strong teeth. Carapace smooth, excepting the dorsal carinæ, which are slightly tuberculated. Frontal margin armed on each side with two large teeth, and the hepatic region bearing one small tooth.

Pleon having the teeth on the dorsal median line reduced to very slight elevations, most conspicuous on the posterior somites.

Telson slightly longer than the lateral plates of the rhipidura.

	Largest male.		Female.	
Length, entire,	52	mm. (2 in.).	59	mm. (2·3 in.).
„ of carapace,	16	„	16	„
„ of rostrum,	14	„	14	„
Breadth of carapace,	10	„	11	„
Length of pleon,	36	„	43	„
„ of third somite of pleon,	5	„	6	„
„ of sixth somite of pleon,	5	„	6·5	„
„ of telson,	11	„	13	„
„ of scaphocerite,	6·5	„	8	„
„ of first pereiopod,	12	„	16	„
„ of second pereiopod,	22	„	20	„
„ of fifth pereiopod,	23	„	23	„

Habitat.—Station 175, August 12, 1874; lat. 19° 2′ S., long. 177° 10′ E.; near the Fiji Islands; depth, 1350 fathoms; bottom, Globigerina ooze; bottom temperature, 36°. Twenty-two specimens; six males, five well-developed females bearing ova, and eleven others, either small males or immature females. Trawled.

This species corresponds with *Glyphocrangon nobilis*, A. Milne-Edwards, which was taken at a depth of 1131 fathoms off the Island of Dominica in the West Indies. They correspond in the form and length of the rostrum, in the length and upward curve of the telson, particularly in the male, but in *Glyphocrangon nobilis* the surface of the carapace and pleon is covered with a number of "rugose prominences," whereas in the specimens from Fiji the whole of the surface of the carapace is smooth, excepting the dorsal carinæ, which are slightly tuberculated, as well as the outer or second carina, and the general surface of the gastric region, there being a small but

decided tooth in the median line at the anterior extremity of that region. In species of this genus, the teeth along the median line of the pleon are generally so connected longitudinally that when the animal is extended they form a distinct carina, continuous from the anterior margin of the first somite of the pleon to that of the telson. In this species there is no elevation that can be called a tooth, or any ridge capable of being denominated a carina, excepting at the posterior extremity of the sixth somite, which is prolonged to a strong point. The median tooth on the frontal margin of the first somite exists only as an elevation of no great importance, and apparently valueless in checking the backward strike of the pleon; all the other somites have the ridge reduced to a mere thickening of the central tissue, and the tuberculations are reduced to smooth prominences, most conspicuous on the coxal plates.

The first pair of antennæ has the peduncle about half the length of the rostrum and subequal with the scaphocerite; the outer flagellum does not appear to be conspicuously larger in the male than in the female.

The number of specimens taken shows the gregarious habit of the species. The fully grown females were generally laden with ova, and are mostly about one-seventh larger than the males.

Glyphocrangon rimapes, n. sp. (Pl. XCIV. fig. 4).

Like *Glyphocrangon granulosis*, but armed with three teeth on each side of the rostrum, and having the dactylos of the posterior pair of pereiopoda terminating in a bifid or cleft extremity.

Length, entire,	104 mm. (4 in.)
„ of carapace,	31 „
„ of rostrum,	19 „
Width of carapace,	19 „
Length of pleon,	73 „
„ of third somite of pleon,	9 „
„ of sixth somite of pleon,	10 „
„ of telson,	22 „
„ of scaphocerite,	15 „
„ of first pereiopod,	23 „
„ of second pereiopod,	34 „
„ of fifth pereiopod,	37 „

Habitat.—Station 300, December 17, 1875; lat. 33° 42′ S., long. 78° 18′ W.; near Juan Fernandez; depth, 1375 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·5. Two specimens; female. Trawled.

Station 237, June 17, 1874; lat. 34° 37′ N., long. 140° 32′ E.; near Yokohama;

depth, 1875 fathoms; bottom, blue mud; bottom temperature, 35°·3. One specimen, female. Trawled. Length, 74 mm.

Station 331, March 9, 1876; lat. 37° 47′ S., long. 30° 20′ W.; South Atlantic, between Buenos Ayres and Tristan da Cunha; depth, 1715 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·4. One specimen; female, bearing ova. Trawled. Length, 87 mm.

This species bears a close resemblance to *Glyphocrangon granulosis*, but the rostrum is comparatively longer, reaching quite to the extremity of the peduncle of the first pair of antennæ; it is armed on each side with three teeth, of which the anterior is long, slender, and situated considerably in advance of the eyes, the second is on a line with the orbital margin, and the third is situated close behind the second; still further back, on the ridge continuous with the lateral margin of the rostrum, is another large tooth. Running along the centre of the rostrum is a minutely elevated thread-like line, as in most species of this genus; in this species it becomes more conspicuous on the frontal region, and gradually passes into a row of small tubercles on the anterior portion of the gastric region, where it gradually fades away. The several carinæ on the dorsal and lateral surfaces of the carapace are more or less tuberculated, and assume a denticulated appearance on the former. The intercarinal surface as well as the hepatic and branchial regions are thickly covered with coarse granulations.

The pleon corresponds nearly with that of *Glyphocrangon granulosis*, but has certain details more decidedly pronounced. The teeth at the extremity of the lateral coxal plates are rather longer, and the boss or large protuberance that corresponds externally with the articulation of the pleopoda on the inner surface is armed with a strong tooth.

The telson is longer than the lateral plates of the rhipidura, is dorsally deeply channelled, and has the lateral margins smooth. The appendages have no specific distinctive character, excepting that the ophthalmopoda are rather smaller, and the dactylos of the posterior pair of pereiopoda (fig. 4*o*) is broad, flat, and bifid or cleft at the extremity. Of the two specimens taken at Station 300 one is about twice the size of the other. The larger is that from which the description and figure were taken, whereas the smaller, though corresponding with it in every essential detail, differs somewhat in the degree of the development of several parts, more particularly in the absence of a tooth on the bosses attached to the outer surface of the coxal plates of the pleon.

In the middle of the South Atlantic, at Station 331, another specimen was trawled which was nearly 87 mm. long, and has no teeth on the bosses of the coxal plates of the pleon. Another specimen about the same length was trawled at Station 237, in which teeth on the lateral bosses of the pleon are present. This animal is well developed, and is a female laden with about thirty large ova.

In these several specimens from very distant localities, the presence of an extra tooth on the lateral margin of the rostrum, and the cleft condition of the dactylos of the posterior pair of pereiopoda are constant, and the sharp spine-like tooth attached to the boss on the coxal plates of the pleon is present in the best-developed forms, but that its presence is not a specific feature may be inferred from the circumstance that in one specimen it is found to exist on one side and not on the other, the absence in some instances being probably due to friction.

The type of this species was brought up by the trawl in the same locality in the South Atlantic (Station 133) at which *Willemœsia leptodactyla* was obtained, and it is worthy of remark that while in this last-named genus the organs of vision are reduced to a rudimentary condition, those of *Glyphocrangon* are unusually large.

Nika, Risso.

Nika, Risso, Crust. de Nice, p. 84, 1816.
,, Milne-Edwards, Hist. Nat. Crust., t. ii. p. 363.
,, Bell, Brit. Crust., p. 273.
,, Dana, U. S. Expl. Exped., Crust., p. 533.
Processa, Leach, Malacos. Pod. Brit., pl. i.

Carapace smooth, about one-third of the length of the animal; anteriorly produced to a short smooth rostrum, horizontal with the dorsal surface and not laterally compressed. Outer canthus of the orbit defined by a small projection of the margin, beyond which is an antennal tooth, between the two antennæ, whence the margin is smooth to the fronto-lateral angle, which is defined by an imperfect point.

The pleon is smooth and the somites subequal in length, the first being divided, the anterior portion passing under the carapace.

Telson long, slender and tapering.

Ophthalmopoda short, uniarticulate. Ophthalmus subreniform; having no ocellus.

First pair of antennæ having a rounded concave stylocerite at the base, and terminating in two unequal flagella.

The second pair of antennæ is subequal in length with the animal, and carries a long scaphocerite, squamose on the inner side, strengthened and toothed on the outer.

Mandibles without either a psalistoma or synaphipod.

The first pair of siagnopoda has three branches, one of which is membranous and rudimentary, the other two short and tipped with hairs.

The second pair has a rudimentary central or primary branch and a large squamose plate of extreme tenuity projecting anteriorly and posteriorly.

The third pair is squamose, having a rudimentary central branch and two squamose plates; the inner is narrow and fringed with strong hairs, the outer broad, rounded

distally, fringed with long hairs, and produced to a long and flat rod-like appendage of great tenuity and fringed with ciliated hairs.

The first pair of gnathopoda is subpediform, short, robust, with the distal joints reflexed, and carries a basecphysis.

The second pair is pediform, long, robust and terminally pointed, without a dactylos.

The first pair of pereiopoda is asymmetrical; the appendage on the right side is robust and chelate; that on the left is also robust but simple. The second pair is similar in form but different in length. That on the left side is short, that on the right is long, and both have a long and slender multiarticulate carpos. The posterior three pairs of pereiopoda are long, slender and simple, the carpos being as long as the meros and ischium combined, and terminate in a slender, sharp, smooth dactylos.

The pleopoda are biramose, and the terminal pair, which helps to form the rhipidura, has a diæresis on the outer branch.

The branchiæ I have not examined in the only specimen in the collection, but in *Nika edulis*, from the southern coast of England, in my own collection, there are five pleurobranchiæ, which are suspended near the upper extremity of the chamber, but no other plume or mastigobranchial plates; their disposition is shown in the following tabular arrangement:—

Pleurobranchiæ,	.	.	.	...	...	1	1	1	1	1
Arthrobranchiæ,	.	.	.	...	...	...	...	...	...	...
Podobranchiæ,	.	.	.	...	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	...	...	...	...	...	...	...
				h	i	k	l	m	n	o

Being unwilling to injure the only specimen in the collection, I have taken the figures of the different parts separately from a British specimen, which appears to differ in little else than size from that brought home by the Challenger, which I have named "*processa*," the name given by Dr. Leach to the genus previously to his being aware of Risso's description.

The eggs borne by the species of this genus are oval in form and numerous; they differ from those of most other genera in having the vitellus floating in the centre of a quantity of transparent fluid.

The form of the brephalos has not been determined.

Geographical Distribution.—Species have been taken, but sparingly, in various parts of the world. The typical form of the genus was first found by Risso in the Mediterranean in 1816, and by others in the European waters as far north as Scotland. Stimpson records it from Madeira, as well as *Nika macrognatha* from Hong Kong. Dana describes a species, *Nika hawaiensis*, from the Pacific; the Challenger specimen was taken off Amboina in the Eastern Archipelago; *Nika japonica*, de Haan, was taken further north, off the eastern coast of Asia.

The resemblance of the several species to each other appears to be great; the only appreciable distinction in the several descriptions, as given by their authors, exists in the variation of length and form of the rostrum.

Nika processa, n. sp. (Pl. XCV.).

Carapace one-third the length of the animal, anteriorly produced to a narrow pointed rostrum, subequal in length with the ophthalmopoda. Pleon smooth, having all the somites dorsally parallel.

The ophthalmopoda are pyriform and stand upon a small pedicle. The ophthalmus is large and reniform.

The first pair of antenna has the first joint deeply excavate on the upper surface, the second is cylindrical and as long as the first, and the third short and terminally supporting two unequal flagella, the shorter being subequal in length with the peduncle, the longer subequal with the animal.

The second pair carries a scaphocerite that is subequal in length with the peduncle of the first pair, and terminates in a long flagellum, now broken off at the length of the carapace, but in its perfect state it was probably longer than the animal.

The second pair of gnathopoda has the terminal two joints together shorter than the antepenultimate.

The first pair of pereiopoda has the left limb, which is of generic value, broken off; that on the right is shorter than the second pair of gnathopoda, it is tolerably robust and terminates in a small chela. The second pair is long and slender, it has the carpos multiarticulate, and terminates in a minute chela; the right appendage being longer and more flexible than the left. The last three pairs are long and slender, the carpos being equal in length to the ischium and meros combined, and more than twice the length of the propodos; the dactylos is long and styliform.

Length, 26 mm. (1 in.).

Habitat.—Amboina; depth, 15 fathoms. One specimen; female.

Observations.—This was the only specimen of this species taken during the Challenger Expedition, and it is laden with numerous small ova. It bears a close general resemblance to the European type (*Nika edulis*); it appears to differ from it chiefly in size, the latter being three inches long, in the form of the ophthalmopoda, which are more pear-shaped, and in the length of the pereiopoda, which are more slender.

On the label within the bottle the specimen is recorded as having been taken on the 6th October 1874, at a depth of 15 fathoms, at Amboina, the most southern island of the Molucca Group, near Station 195, while in the list of Stations the sounding is given as 1425 fathoms, so that, the Station being about 30 miles from shore, we may assume our specimen to have been a straggler taken near the surface.

Family Alpheidæ.

This family consists of those genera that have the following common characters:—The rostrum reduced to a minimum; the ophthalmopoda short and entirely covered by the projection of the frontal margin of the carapace; the mandible carrying a psalistoma distinct from the molar process, and a two-jointed synaphipod; the first pair of pereiopoda asymmetrical, on one side having the carpos short and the propodos large and normal in form, and on the other very large and variably irregular; the second pair of pereiopoda long and slender, with the carpos multiarticulate and terminating in a minute chela; and, finally, the telson broad and rounded.

Athanas, Leach.

Athanas, Leach, Edin. Encycl., vol. vii. p. 432.
,, Leach, Malacos. Pod. Brit., pl. xliv.
,, Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 365.

Dorsal surface of the carapace without a carina; anteriorly produced to a rostrum, not laterally compressed; orbital margin furnished with a supraorbital tooth.

Pleon smooth and gradually tapering.

Ophthalmopoda short, scarcely reaching beyond the frontal margin of the carapace.

First pair of antennæ having a long stylocerite, and terminating in two flagella, of which the upper is unequally biramose.

Second pair long, slender, and carrying a long ovate scaphocerite, armed with a distal external tooth.

Mandible furnished with a two-jointed synaphipod.

Second pair of gnathopoda pediform, five-jointed, robust.

First pair of pereiopoda subequal, symmetrical, robust, chelate. Second pair multiarticulate, minutely chelate. Three succeeding pairs simple.

Rhipidura well developed.

Telson dorsally flat and laterally tapering.

Geographical Distribution.—European Shores and Cape Verde Islands.

Hitherto the genus has been represented only by one species, and that sparingly taken on the coasts of England and Norway. On the coasts of Devon and Dorset, and the Channel Islands, it has been taken occasionally and sometimes abundantly, and Sars records it from Christiania Fjord in Norway. I am not aware of its having been previously taken elsewhere, but the new form, *Athanas veloculus*, was captured off the Cape Verde Islands by the Challenger.

Athanas veloculus, n. sp. (Pl. XCVI. fig. 1).

Rostrum reaching nearly to the extremity of the peduncle of the first pair of antennæ.

Ophthalmopoda almost hidden beneath the anterior margin of the carapace.

First pair of antennæ furnished with a long stylocerite, and supporting two flagella, of which the upper is unequally bifid. Scaphocerite of the second pair of antennæ reaching to the extremity of the rostrum.

Second gnathopod reaching beyond the scaphocerite.

Length, entire, ...	7 mm. (0·27 in.).
„ of carapace, ...	2 „
„ of pleon, ...	5 „

Habitat.—Cape Verde Islands. Two specimens.

This species bears a resemblance to *Athanas nitiscens*, Leach, the type of the genus, but differs in having the ophthalmopoda covered to a greater extent by the orbital margin of the carapace, a portion of the ophthalmus alone being visible. Above the eye on the inner side of the orbit there is a small sharp tooth, which does not exist in *Athanas nitiscens*, and the outer canthus is also produced to a strong tooth, external to which the frontal margin is produced and armed with a sharp tooth both above and below the first antennæ, and the fronto-lateral angle is rounded.

Both pairs of antennæ correspond with those of *Athanas nitiscens*, or differ only in points of specific value. The oral appendages have not been examined in this species, but the second pair of gnathopoda is relatively longer than that represented in Leach's figure of *Athanas nitiscens*.

The first pair of pereiopoda is wanting in our specimens. The second is slender and has the carpos multiarticulate, but comparatively longer than in *Athanas nitiscens*. The three posterior pairs are simple and similar in form; the carpos is short, the propodos long, cylindrical, and fringed with hairs on the posterior margin; the dactylos is short and unguiculate.

The pleopoda are biramose and foliaceous, and the lateral plates of the rhipidura are longer than the telson. The outer plate is furnished with a well marked diæresis, the outer margin of which is defined by a small tooth, beyond which the outer plate as well as the inner is fringed with hairs. The telson is tapering, dorsally armed on each side with three single spinules and terminally fringed with small hairs.

Observations.—Although the infraorbital tooth is of generic rather than specific value, I do not consider myself justified in separating this species from *Athanas* until more and better specimens have been examined.

Parathanas, n. gen.

Animal robust. Carapace about one-third of its length. Rostrum short. Pleon having the sixth somite nearly as long as the two preceding. Telson half the length of the sixth somite.

Ophthalmopod short, orbicular.

First pair of antennæ considerably longer than the ophthalmopoda and terminating in two flagella.

Second pair carrying a long and narrow scaphocerite.

First pair of pereiopoda robust, chelate; second pair slender, chelate, having the carpos multiarticulate; third and fourth pairs short and simple; fifth pair very long and slender, and (probably) styliform.

There is only one perfect specimen in the collection and that is immature. It is closely allied to *Athanas*, but differs from that genus in having only two simple flagella, one of which is very short, attached to the extremity of the first pair of antennæ, and in having the posterior pair of pereiopoda longer than the preceding.

Geographical Distribution.—The two species were taken near the Celebes Islands.

Parathanas decorticus, n. sp. (Pl. LXXXIX. fig. 3).

Animal moderately robust. Rostrum short, dorsally smooth and pointed.

Ophthalmopod orbicular, scarcely longer than the rostrum. First pair of pereiopoda larger than the second; second more slender, but not longer than the first; posterior pair of pereiopoda longer than the others.

Telson pointed.

Length, entire,	6	mm. (0·23 in.).
„ of carapace,	2	„
„ of rostrum,	0·5	„
„ of pleon,	4	„
„ of sixth somite of pleon,	1·3	„
„ of telson,	1	„

Habitat.—October 23, 1874; taken off Sibago, Samboangan, Philippine Islands, in 80 fathoms. One specimen.

The animal generally is tolerably robust. The carapace, which is 2 mm. long, is rather more than one-third the length of the animal, measured from the frontal margin to the extremity of the telson; the rostrum is short, being about one-fourth the length of the carapace, and is dorsally flat, smooth, and pointed.

The pleon has the anterior somites shorter than the posterior, of which the fourth

and sixth are the longest, the fifth being shorter than the fourth; the sixth, which is 1·3 mm. long, is nearly equal to the fourth and fifth together. The telson is long, narrow and pointed.

The ophthalmopoda are short and orbicular, reaching but slightly beyond the apex of the rostrum.

The first pair of antennæ consists of a peduncle of three joints, of which the first or basal joint reaches considerably beyond the extremity of the eye, the second and third joints are short and subequal, and terminate in two slender flagella, the outer of which consists of four short articuli that taper to a point, and the inner is slender and broken off at a short distance from the base. The second pair of antennæ carries a long and narrow scaphocerite, that is armed with a small tooth at the outer distal extremity. The flagellum is broken off close to the peduncle.

The oral appendages have not been examined, as they could not be dissected out without risk to the specimen.

The first pair of pereiopoda (fig. 3*k*) is tolerably robust, and terminates in an ovate chela, of which the fingers are about one-third the length of the palm; the carpos is short, and, like the meros, which is tolerably long, increases in size towards the distal extremity. The second pair of pereiopoda (fig. 3*l*) is subequal in length with the first, but is much more slender, and also terminates in an ovate chela of which the fingers are about one-fourth the length of the palm; the carpos is longer than the propodos and quinque-articulate, the distal articulus being the longest. The third and fourth pairs of pereiopoda (figs. 3*m*, 3*n*) are alike in size and form, and are subequal to the second pair, but terminate in a short, sharp pointed, and simple dactylos. The fifth pair is broken off beyond the meros, but the portion that remains indicates a much longer appendage; like the preceding, the basis and meros are short and stout, whereas the meros is long, slender, and straight, almost equalling the entire length of the preceding perfect limb.

The first pair of pleopoda is single-branched, and the four succeeding pairs are biramose. The terminal pair, which forms the outer plates of the rhipidura, is biramose.

Observations.—The specimen from which this description is taken is evidently an immature animal, and it is not improbable that in a more fully developed condition some parts may vary in their proportions.

It cannot be the young of *Athanas*, on account of the form of the first pair of antennæ, and of the length of the posterior pair of pereiopoda.

The animal, when it was captured, was just about to cast its exuvium, which hangs about it as a thin transparent membrane, and the form which I have just described is rather that of the future appearance than of the loose external skin.

The scaphocerite is visible within the external exuvium, and its form is more perfectly defined than in the latter; the hairs, which are absent from the envelope, are distinctly visible in their connection with the new structure.

The form of the first pair of pereiopoda exactly corresponds with the dermal tissue, excepting that the chelate hand appears to be formed within a case in which the fingers are enclosed within one sac. The second pair is still more evidently undergoing a change, for not only is the hand with its two fingers confined in one and the same sac, but the five articuli of the carpos are enclosed within one continuous envelope, which is minutely corrugated, as if it had the capacity of being stretched by the growth of the included organ.

The third and fourth pairs of pereiopoda are also visible within the outer sac, through the extremity of which the point of the dactylos appears to force its way.

The outer plates of the rhipidura and telson are also seen to be undergoing a change within the exuvium; the outer branch appears to be dividing to form the diæresis, and the hairs at the extremity are all telescoped in their length, as if on being liberated they were capable of shooting out to their full extent.

Parathanas immaturus, n. sp.

A damaged specimen of what appears to be another species was taken in the same region, in Zebu Harbour, in January 1875, at the surface of the sea.

The only distinguishable difference is that the rostrum is longer in proportion to the animal, which has a length of scarcely 5 mm. (0·19 in.).

Unfortunately all the pereiopoda are broken off short, and there is little to determine the true character of the specimen.

Cheirothrix, n. gen.

Carapace anteriorly produced to a sharp rostrum that is separated by a groove from the orbital lobes, which are anteriorly produced to a sharp point. Fronto-lateral angle produced to a point. Anterior somites of the pleon as deep as the carapace.

Ophthalmopoda reduced to a minimum and concealed beneath the frontal margin of the carapace.

First pair of antennæ biramose and furnished with a well-developed stylocerite.

Second pair furnished with a short and broad foliaceous scaphocerite, which is strengthened on the outer side by a rigid margin and a small tooth.

First pair of gnathopoda having the terminal joints reflexed, the basis carrying a long and slender ecphysis.

The second pair is slender, four-jointed, and pediform.

The first pair of pereiopoda has large chelæ. The second pair is shorter than the third, slender, having a carpos with five articuli, and terminating in an extremely minute

chela, which breaks up into a brush of numerous, peculiar, thick, scaly hairs. The three succeeding pairs of pereiopoda are moderately robust and terminate in a single unguis.

The pleopoda are biramose, and the rhipidura well developed.

This genus, if it be separate from *Alpheus*, rests its characters chiefly on the form of the second pair of pereiopoda, which, instead of having the carpos long, multiarticulate, and terminating in a small chela, has it short and only five-articulate, the propodos being long, narrow, and gradually tapering to a point that is tipped with a brush of radiating hairs. The dactylos with the polliciform extremity forms an extremely small chela, which is scarcely determinable under a magnifying power of sixty diameters, and the fingers of which are broken up into and support numerous hairs.

Cheirothrix parvimanus, n. sp. (Pl. XCVI. fig. 2).

Dorsal surface of the carapace continuous in the same horizontal line with the pleon. Rostrum slightly elevated at the apex; frontal margin of the orbital lobes produced to a sharp point reaching nearly as far as the rostrum.

Pleon having the somites anteriorly as deep as the carapace and gradually lessening posteriorly.

The ophthalmopoda are short and entirely hidden beneath the carapace.

The first pair of antennæ has the first joint of the peduncle subequal with the length of the rostrum, and carries a strong stylocerite that reaches beyond the extremity of the first joint; the second and third joints are short, and together subequal with the first, the third supports two flagella, of which the principal one is the shorter and is furnished with a thick mat of membranous cilia, and the other is equal in length to the carapace.

The second pair of antennæ is nearly as long as the animal and supports a scaphocerite that is broad, ovate, and armed with a tooth on the outer margin.

The first pair of gnathopoda has the distal joints reflexed, and the basisal carries a long ecyphsis.

The second pair is long and slender, carries a long basecphysis, and is tipped with several small spinules.

The first pereiopod on the left side has the propodos long and subcylindrical, the pollex straight, slightly oblique, and tapering, and the dactylos longer than the pollex, and at the extremity strongly curved and pointed. The second pair of pereiopoda is short, having the carpos five-articulate, the propodos long and tapering, and at the extremity tipped with a radiating bunch of hairs.

The rest of the animal is like *Alpheus*, but since the first pereiopod has been lost from the right side, there is no means of determining whether the pair be symmetrical, as in *Athanas*, or asymmetrical, as in *Alpheus*. I am, therefore, induced to consider it as a link between these two genera.

Length, entire,	13	mm. (0·5 in.).
„ of carapace,	4	„
Depth of carapace,	3	„
Length of pleon,	9	„
„ of second gnathopod,	5	„
„ of large chela,	4	„
„ of second pereiopod,	4·5	„
„ of telson,	2·5	„

Habitat.—Station 186, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; off Cape York; depth, 8 fathoms; bottom, coral mud. One specimen. Dredged.

The dorsal surface of the carapace is not elevated over the gastric region, and the rostrum runs to a sharp point slightly directed upwards anteriorly. The orbital lobes correspond much with those in *Neptunus biunguiculatus*, and the ophthalmopoda (fig. 2*a*, *a*) are hidden under the frontal margin of the carapace, which is not sufficiently thin over the ophthalmus to permit of the latter being seen through it, but it is visible in front when viewed anteriorly.

The first pair of antennæ (fig. 2*b*) has the first joint subequal in length with the rostrum; it is excavate on the upper surface and carries a large stylocerite, at the base of which may be seen the acoustic apparatus in the form of a transparent spherical chamber with a small round body within. The stylocerite is pointed and reaches beyond the extremity of the first joint; the second and third joints are shorter than the first, and terminally support two flagella, the primary, which is the more robust, widens for a distance and carries a considerable number of closely packed membranous cilia, after which it rapidly narrows to a slender extremity; the second flagellum is about twice the length of the first and more slender; it is about the length of the carapace.

The second pair of antennæ (fig. 2*c*) has a flagellum that is about the length of the animal, and carries a scaphocerite that is a little longer than the peduncle of the first pair; it is broad and rounded at the extremity, and armed on the outer side with a short, stout, sharp tooth, and on the inner and distal margins with long and ciliated hairs.

The mandibles and oral appendages have not been examined in the solitary specimen.

The first pair of gnathopoda (fig. 2*h*) apparently consists of only four joints; the basis, meros, and ischium appear to be united together to form a single joint, and from a prominence near the base of this joint an ecphysis arises that is slender, flexible, nearly double the length of the whole appendage, and multiarticulate almost from the base to the apex, where there are a few unimportant hairs. The next joint is short and probably homologises with the carpos, and the propodos articulates with it on its inner rather than on its distal surface; the latter is long, broad and curved, the lateral margins being parallel, the anterior concave, and the posterior convex; the distal extremity is oblique, straight, and fringed with a series of numerous closely packed

hairs. The anterior margin near the carpal extremity has a small lobe, from the surface of which radiate four stiff straight hairs or spines; this lobe appears to be imperfectly articulated to the propodos, and if so must be the homologue of the dactylos.

The second pair of gnathopoda (fig. 2*i*) is pediform. It is slender and consists of four joints, of which the coxa is broad, the second joint is narrow, and near the base, which is considerably more slender than the first joint, is a long uniarticulate basecphysis, that is equal in length to the joint to which it is attached, which, I consider represents the basis, ischium, and meros fused into one; the third joint, which represents and probably homologises with the carpos, is short, and the terminal joint, which is probably the propodos, is long, slender and slightly tapering; it is terminally armed with three or four short spinules, and fringed on the inner side with several small bundles of hairs.

The first pair of pereiopoda has, in our specimen, the appendage on the right side missing; that on the left is large, but neither of excessive nor abnormal growth; the ischium unites with the meros by an oblique and semi-anchylosed articulation; the carpos is short, slightly produced on the lower margin and excavate on the anterior margin both above and below the point of articulation with the propodos; the propodos is not broader than the carpos, and measured to the extremity of the pollex it is nearly as long as the carapace, it is nearly cylindrical, with the margins slightly waved and parallel; the pollex is long, straight and tapering, it is slightly oblique to the longitudinal axis of the propodos, and impinges closely against a long, curved, and tapering dactylos, which, when closed, overlies and curves over the extremity of the pollex.

The second pair of pereiopoda (fig. 2*l*) is shorter and more slender than the first; the coxa is the shortest and most robust joint; the basis is short and articulates obliquely with the ischium, projecting on the under surface; the ischium is long, enlarges near the middle, and tapers slightly to the meros, with which it articulates at the extremity; the meros is as long as the ischium, enlarges near the middle, and tapers to the carpos, which is a little longer than the meros and is five-articulate, the articuli at the proximal and distal extremities being the longest, and the three in the middle short and equal; the propodos is nearly as long as the carpos, and of the same diameter at the base, whence it gradually tapers to the extremity, from which a bundle of curiously formed hairs radiates, forming a peculiar brush. The chela is extremely minute, since it is difficult to be determined under a power of sixty diameters, but under a higher power it becomes visible (fig. 2*l*″), the extremity of each finger gradually passing into the condition of a broad hair, and these are flanked on both pollex and dactylos by longer hairs of a similar kind. These hairs (fig. 2*l*‴) appear to be of the same diameter from base to apex, but near the base and for about half their length the surface appears to consist of scales which gradually pass into minute hairs forming a closely packed fur towards the extremity. I counted about twelve in all; they are large in proportion to the size of the chela. In species of *Alpheus* numerous strong but simple hairs not infrequently adorn the

fingers of the chela, but they are only subservient to the larger organ, while in this case the chela is rudimentary. The presence of long calcified tendons within the propodos is strong evidence that the dactylos is a movable joint, and the movable power that it possesses must have its usefulness increased by the presence of these long hairs. It appears to offer an example of how a simple and apparently useless organ may by adaptation become converted into one of importance.

The third pair of pereiopoda is longer than the second and more robust, and terminates in a short, single, sharp pointed unguis; the carpos and the meros at their distal articulation on the upper surface overlap the next succeeding joint. The fourth pair of pereiopoda resembles the third in proportion and form. The fifth is shorter and terminates in a stunted dactylos.

The pleopoda are biramose and subequal.

The lateral plates of the rhipidura are longer than the telson and possess a small diæresis.

The telson is long, slender, and tapering.

Observations.—This, our only specimen, is small and semi-transparent. It was dredged in the same locality as *Synalpheus*, *Paralpheus*, *Alpheus avarus*, and that which I have thought resembles *Alpheus acuto-femoratus*. The form of the chela in this species so greatly corresponds in appearance with that of the right or smaller one in *Synalpheus falcatus* that I at first thought it must be a younger form of that species, or at least of some species of the same genus, but an examination of certain parts renders this most improbable. In *Synalpheus falcatus* the dorsal surface of the carapace is elevated into a carina, which decreases in intensity on the pleon, but still remains conspicuous, although more as a dorso-lateral compression than as a distinct keel. In *Cheirothrix parvimanus* the carapace is not elevated and the dorsal surface is smooth and even. In *Synalpheus* the first pair of antennæ has a tendency to divide into two at the extremity of the stouter flagellum, which does not appear to be the case in *Cheirothrix*. The second pair of antennæ in *Synalpheus* has the scaphocerite sharp pointed, and the outer styliform process separated from the inner foliaceous plate by nearly half its length. In *Cheirothrix* it is broad and ovate, rigid on the outer margin, and connected with the foliaceous plate to near its distal extremity, where it terminates in a short tooth. The first pair of gnathopoda differs in form, and also apparently in structure, since in *Synalpheus* the position of the dactylos varies from that in *Cheirothrix*, and in the latter genus the second pair at its distal extremity is tipped with short spinules, while in *Synalpheus* it terminates in two points and a few fine hairs.

The generic distinction between this species and those of *Alpheus* or its allies must rest upon the importance of the change in the form of the second pair of pereiopoda.

In all species of *Alpheus* and its related genera the second pair of pereiopoda is as long as, or longer than the third pair, it is slender and has the carpos more or less

numerously multiarticulate, and terminates in a small but apparently efficient chela, generally ovate in form. In *Cheirothrix* the second pair of pereiopoda is shorter than the third, the carpos is only a trifle longer than the meros and only five-articulate, and the propodos is as long as the carpos—a feature unknown in *Alpheus*—and instead of being ovate it gradually tapers from the same diameter as the carpos to a point, which appears to be broken into hairs of unusual and peculiar form as above described.

It is to be regretted that there is but one specimen, which precludes my being able to examine other and less conspicuous parts.

Alpheus, Fabricius.

Alpheus, Fabricius, Suppl. Entom. Syst., p. 404, 1778.
„ Risso, Crust. de Nice, p. 88, 1816.
Alphæus, Desmarest, Consid. sur les Crust., p. 222, 1825.
Alpheus, Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 349.

This genus was first established by Fabricius, but was not clearly defined until Milne-Edwards described it.

The whole of the animal is dorsally rounded and laterally compressed; the ophthalmopoda are reduced in size, so that they are hidden beneath the anterior region of the carapace, which is so extremely thin over them as to become transparent, thus protecting the eyes without interfering with vision. The rostrum is short and pointed.

The first pair of antennæ has the peduncle short; the first joint is flattened, and carries a short stylocerite on the outer side, and the terminal supports two flagella, the inner of which has a tendency to bifurcate.

The second pair carries a long flagellum and a strong scaphocerite that terminates in a subapical point or sharp tooth.

The mandibles are robust, furnished with a molar protuberance distinctly separated from the concave and serrate psalistoma, and carry a short three-jointed synaphipod.

The first pair of gnathopoda is short and five-jointed, the ultimate joint articulated at the inner and posterior angle of the penultimate, and reflexed against its inner margin.

The second pair of gnathopoda is pediform, five-jointed, subcylindrical, and carries a short and slender basecphysis.

The first pair of pereiopoda is chelate, carries a large propodos, that on the right side being generally larger than that on the left, and is of a more or less abnormal form especially in the male. The second pair of pereiopoda is slender, minutely chelate, having the carpos long, cylindrical, and multiarticulate. The posterior three pairs are simple and terminate in a short robust dactylos.

The pleon is short and terminates in a telson that is broad and rounded; the outer plates of the tail-fan are furnished with a strongly marked diæresis.

The branchial arrangement, as I have observed it in the specimens of *Alpheus edwardsii* from the Cape Verde Islands, may be tabulated as follows :—

Pleurobranchiæ,	...	...	1	1	1	1	1
Arthrobranchiæ,	...	1	...	...	...	...	...
Podobranchiæ,	...	...	...	...	...	...	...
Mastigobranchiæ,	r	r	r	r	r	r	...
	h	i	k	l	m	n	o

The mastigobranchiæ are all rudimentary in appearance, but they evidently have some office to fulfil, since they terminate in a strong and peculiarly shaped hook.

The branchial plume belonging to the second pair of gnathopoda is small, and consists of a bundle of leaflets attached to the flexible membrane of the coxal articulation.

Development.—The brephalos in this genus may be a Zoea or Megalopa. In the Zoea (Pl. LXXXIX. fig. 4) there is neither rostrum nor dorsal tooth, and the ophthalmopoda are large. The figure is from a specimen obtained direct from the parent by Mr. Power, from a species resembling *Alpheus neptunus*, Dana, procured at the Mauritius. The ophthalmopod is orbicular and consists of the ophthalmus only. The first pair of antennæ has a single-jointed peduncle and two small branches, one being a long plumose hair, the other short, conical, and carrying three membranous cilia. The second pair of antennæ consists of a peduncle, flagellum, and scaphocerite which is multiarticulate and fringed with hairs. The oral appendages I have not examined, but they are succeeded by three pairs of biramose apppendages, by the deciduous representatives of the third pair of siagnopoda, and the first and second pairs of gnathopoda. Posterior to these there appear to be no other appendages either on the pereion or pleon. The telson terminates in a broad fish-tail fan, fringed with ciliated hairs and flanked by a simple spine at each extremity. A specimen which I consider to be the young of this genus was taken at the surface, off the African coast of the Atlantic, on April 13, 1876, apparently only recently hatched.

In some species the brephalos appears to be in a more advanced form and is hatched in the Megalopa stage (Pl. CXXII. fig. 1), and this distinction occurs in species very closely resembling those producing the Zoea form.

This peculiarity of development was first described by myself in a memoir with drawings communicated to the Royal Society,[1] from specimens obtained by Mr. Power in the Mauritius, and the fact has since been confirmed by Mr. Packard.[2]

The original of my drawing is 2 mm. in length and was procured from a specimen 14 mm. long, resembling the figure that I have given of *Alpheus minus*, Say.

The carapace is about one-fourth the length of the animal and has no rostrum. The

[1] *Proc. Roy. Soc.*, vol. xxiv. p. 375, 1876.

[2] *American Naturalist*, vol. xv. p. 788, 1881.

pleon is nearly three times as long as the carapace and terminates in a telson that is rounded at the extremity and fringed with ciliated hairs, flanked with a small spine on each side, and one on each side of the median line.

The ophthalmopod is orbicular and projects free in front of the frontal margin.

The first pair of antennæ carries two short flagella. The second pair is styliform and supports a small bud-like process near the middle.

The mandibles and first pair of siagnopoda have not been examined.

The second and third pairs consist of a peduncle and two unequal branches, the longer, which I take to be the basecphysis, is tipped with four or five long ciliated hairs; the shorter, which appears to be the incipient condition of the permanent joints, terminates in three or four simple hairs.

The first and second pairs of gnathopoda resemble the preceding two pairs of appendages but are slightly longer.

The first pair of pereiopoda is in an advanced condition and chelate, but unequal in form and proportion; that on the right side is the smaller, carries a multiarticulate basecphysis, and consists of a united ischial and meral joint, a short carpos, a propodos that has the margins parallel and forming with the dactylos a well-developed chela; that upon the left side differs in having the propodos very much larger, and the margins of that joint are not parallel, but much larger at the carpal extremity, gradually narrowing distally and terminating in a sharply pointed chela. The three succeeding pairs are biramose and resemble the four anterior, excepting that they are rather longer.

Each of the anterior five somites of the pleon carries a pair of short biramose pleopoda; the sixth is associated with the telson and has as yet no appendage.

The Megalopa was got from the ovum of a near ally of *Alpheus minus*, but differing in having a long powerful tooth on the outer margin of the scaphocerite, the foliaceous part being smaller, membranous and very thin. I previously (*loc. cit.*, *supra*) named this specimen *Homaralpheus*, making it a separate genus, from the impression that species producing a Megalopa could not be placed in the same genus as those producing a Zoea.

Geographical Distribution.—The several species given in the following list, with their habitats and depths, so far as known, appear to belong to the shallow waters or to depths less than 60 fathoms. Only one locality is recorded with a greater depth than this—*Alpheus avarus* having been procured off Japan, at Station 234, in 2675 fathoms, but as this species is known to inhabit comparatively shallow seas, this case is probably due to some acccidental circumstance. Their geographical range is very extensive between the north and south temperate zones, and in one instance a specimen of *Alpheus minus* has been recorded from an inland fresh-water pond in south-west Colorado.

	Fathoms.	Habitat.
Alpheus acuto-femoratus, Dana,	...	Balabec ?
,, *affinis*, Guise (not Kingsley),	...	Channel Islands.
,, *armillatus*, Milne-Edwards,	...	Antilles.
,, *avarus*, Fabricius,	18	Cape York. Off Japan, 2657 fathoms.
,, *bellimanus*, Lockington,	...	California.
,, *bermudensis*, n. sp.,	15	Atlantic.
,, *bidens*, Olivier,	...	Asiatic Sea.
,, *bispinosus*, Streets,	...	Panama.
,, *biunguiculatus*, Stimpson,	18	Hawaii.
,, *bouvieri*, A. Milne-Edwards,	...	Cape Verde Islands.
,, *brevipes*, Stimpson,	...	Hawaii.
,, *brevirostris*, Olivier,	...	Australia.
,, *candei*, Guérin (*transversodactylus*, Kingsley),	...	Key West and Cuba.
,, *charon*, Heller,	...	Nicobar Islands.
,, *chiragricus*, Milne-Edwards,	...	New Zealand.
,, *clamator*, Lockington,	...	California.
,, *collumianus*, Stimpson,	1	Bonin.
,, *crassimanus*, Heller,	...	Australia.
,, *crinitus*, Dana,	18	Asiatic Seas; Balabec Straits.
,, *cristidigitus*, n. sp.,	52	Cape Verde Islands.
,, *cylindricus*, Kingsley,	...	Panama.
,, *dentipes*, Guérin,	...	Mediterranean.
,, *diadema*, Dana,	...	Hawaiian Islands.
,, *doris*, White,	...	
,, *edwardsii*, Audouin,	52	Europe; Cape Verde Islands.
,, *equalis*, Kingsley,	...	Panama.
,, *euchirus*, Dana,	...	Borneo.
,, *floridanus*, Kingsley,	...	Florida.
,, *gracilipes*, Stimpson,	40	Bass Strait; Tahiti.
,, *gracilis*, Heller,	...	Red Sea.
,, *hardfordii*, Kingsley,	...	California.
,, *heterocheles*, Say = *armillatus*, Milne-Edwards,	...	America, Atlantic coast.
,, *heterocheles*, Say = *lutasius*, Saussure,	...	
,, *heterocheles*, Say = *equidactylus*, Lockington,	...	California.
,, *insignis*, Heller,	...	Red Sea.
,, *intermedius*, Stimpson,	...	North Carolina.
,, *intrinsecus*, n. sp.,	7–20	South America.
,, *lævis*, Randal,	1	Pacific; Sandwich Islands.
,, *leviusculus*, Dana,	15	Pacific.
,, *latimanus*, Costa,	...	Mediterranean.
,, *longidactylus*, Kingsley,	...	California.
,, *longimanus*, n. sp.,	5–20	Japan.
,, *lothinii*, Guérin,	...	
,, *malleator*, Dana,	...	Rio Janeiro ?
,, *minus*, Say,	7–20	America, Atlantic coast.
,, *mitis*, Dana,	1	Balabec Passage.
,, *neptunus*, Dana,	6–9	Zooloo Sea; Fiji Islands.
,, *normani*, Kingsley,	...	
,, *novæ-zealandiæ*, Miers,	...	New Zealand.
,, *obeso-manus*, Dana,	...	Fiji Islands.
,, *pachychirus*, Stimpson,	...	Loo Choo.
,, *pacificus*, Dana,	...	Sandwich Islands.
,, *packardii*, Kingsley,	...	Key West.
,, *panamanensis*, Kingsley,	...	Panama.

	Fathoms.	Habitat.
Alpheus parvimanus, Kingsley,	...	Panama.
„ *parvi-rostris*, Dana,	8	Balabec.
„ *prolificus*, n. sp.,	18	Pacific Ocean.
„ *pugilator*, A. Milne-Edwards,	...	Cape Verde Islands.
„ *pugnax*, Dana,	...	Hawaiian Islands.
„ *rapax*, Fabricius,	10	Asiatic Seas.
„ *ruber*, Rafinesque,	6	Europe.
„ *rugimanus*, A. Milne-Edwards,	...	Cape Verde Islands.
„ *socialis*, Heller,	...	Australia.
„ *spinicicerus*, Costa,	...	Mediterranean.
„ *spinifrons*, Milne-Edwards,	...	Chili.
„ *spiniger*, Stimpson,	18	Asiatic Seas, Loo Choo.
„ *strenuus*, Dana,	...	Australia; Tongatabu.
„ *streptochirus*, Stimpson,	20	Cape Verde Islands.
„ *sulcatus*, Kingsley,	...	Panama.
„ *tridentulatus*, Dana,	...	Rio Janeiro?
„ *ventrosus*, Milne-Edwards,	...	Mauritius.
„ *websterii*, Kingsley,	...	United States.

Observations.—The genus may be divided into three divisions—

A. Those without rostrum or supraorbital teeth.

B. Those with rostrum but without supraorbital teeth.

C. Those with rostrum and with supraorbital teeth.

This arrangement, however, can only be considered as convenient for purposes of classification, since the above characters are found to exist in various degrees, and Mr. J. S. Kingsley,[1] in regard to *Alpheus minus*, Say, says:—"In some specimens the ocular spines are present, while the rostrum is wanting; in others the front is truncate, no spines being present. The proportions of the joints of the carpos of the second pair of pereiopoda also vary," and he continues "the relative lengths of rostrum and ocular spines can be of no great importance when they vary as I have shown."

If these observations of Mr. Kingsley be justified by further experience of this intricate genus, then many of the recorded species must be merely varieties. For instance, Dana[2] considers his species of *Alpheus leviusculus*, of which I have figured (Pl. XCVIII. fig. 1) a variety, to be itself only a variety of *Alpheus edwardsii*, and says further that it is near to *Alpheus bi-spinosus* of de Haan, which de Haan considers a variety of *Alpheus avarus* of Fabricius, but which Stimpson affirms to be distinct.

Alpheus avarus, Fabricus, appears to be not very distinct from *Alpheus edwardsii* of Audouin. Yet the figure given in this Report of *Alpheus leviusculus* bears but little resemblance to Audouin's figure of *Alpheus edwardsii*.

Again, some of the species correspond in almost every point except in the presence

[1] Bull. U.S. Geol. Survey, vol. iv., No. 1, p. 191, 1878.

[2] U.S. Explor. Exped., Crust., p. 543, pl. xxxi. fig. 3.

or absence of the supraorbital teeth, as for instance *Alpheus crinitus*, Dana, appears to differ only in this respect from *Alpheus minus*, Say. The one was obtained amongst the islands of the Eastern Archipelago, and the other on the western coast of America.

Alpheus edwardsii (Audouin) (Pl. XCVII. fig. 1).

Athanas edwardsii, Audouin, Planches de la description de l'Egypte par M. Savigny, Crust., pl. x. fig. 1.
Alpheus edwardsii, Dana, U.S. Explor. Exped., Crust., p. 543, pl. xxxiv. fig. 2*a*.
" " Heller, Crust. Fauna des Rothen Meeres, p. 267.
" " Norman, Ann. and Mag. Nat. Hist., vol. ii. p. 173, September, 1868.

Our specimens correspond with those of Dana from St. Iago, Cape Verde Islands, and agree with Audouin's figure more closely than with the description of *Alpheus edwardsii* given by Milne-Edwards, which is a Mediterranean form described by him as having the anterior margin of the orbital lobes armed with a small spine or tooth.

The frontal margins above the eyes are smooth, rounded, and without a supraorbital tooth, projecting nearly to the extremity of the rostrum.

The first pair of pereiopoda has the left hand the larger, the posterior portion is smooth, the anterior suddenly constricted, the pollex is short, curved, and pointed, and the dactylos broad and flat, rounded on the outer side and straight on the inner, forming in section an almost perfect semicircle. The right hand is long and slender, having the fingers nearly as long as the rest of the propodos. The third pair of pereiopoda is without a tooth on the infero-distal angle of the meros.

The males of our specimens are all about one-third smaller than the females. The side on which the larger propodos occurs varies, some having it on the right side instead of the left, but those that have it on the left are proportionally more numerous.

Among those procured at the Cape Verde Islands were numerous small specimens, which from their general appearance I take to be half grown individuals of this species, but besides these immature forms there were numerous others, the females of which were gravid with ova, so closely resembling the small individuals that they could only be separated by close observation. These all have the anterior margin of the orbital lobes armed with a small tooth, and correspond very closely with Milne-Edwards' description; they differ, however, from *Alpheus megacheles* (Pl. XCVII. fig. 4) which I suppose to be that which the distinguished European carcinologist believed to be the same as *Alpheus edwardsii* (Audouin).

The females attain the length of 25 mm. or more, though they reach maturity and become gravid when very small, and even at only half that length, but I have not met with a male that was more than 13 mm. long.

[1] Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 352.

Length—female, 25 mm. (1 in.); male, 13 mm. (0·5 in.).

Length, entire (female),	25	mm.
,, of carapace,	11	,,
,, of pleon,	14	,,
,, of large hand,	13	,,
,, of dactylos of large hand,	4	,,
,, of small hand,	9	,,
,, of dactylos of small hand,	5	,,
,, of telson,	3·5	,,

Habitat.—Off St. Vincent, Cape Verde Islands. The station is not recorded, but it was probably Station 93c, at a depth of 52 fathoms, on coralline mud.

Heller took his specimen in the Red Sea, where probably also that was obtained from which Audouin's original figure was taken.

Off Albany Island, Cape York, a specimen was taken that only differs from the female obtained at the Cape Verde Islands by having the smaller hand upon the left side; the larger on the right side being broken off. Beyond this I see nothing either in form or arrangement of parts that distinguishes it from the Atlantic and Red Sea forms.

Alpheus avarus, Fabricius,[1] appears to have no strongly marked feature separating it from *Alpheus edwardsii*, and I think we shall not be far wrong in saying that *Alpheus edwardsii*, Audouin, *Alpheus avarus*, Fabricius, *Alpheus strenuus*, Dana, *Alpheus parvirostris*, Dana, and *Alpheus pacificus*, Dana, are merely varieties of a cosmopolitan species which have arisen by local selection. Dana considers *Alpheus leviusculus* to be only a variety of *Alpheus edwardsii*.

Mr. Edward J. Miers, F.L.S., late of the British Museum, considers the two specimens which the late Mr. Adam White named *Alpheus doris* and *Alpheus neptunus* to be respectively *Alpheus edwardsii* and *Alpheus strenuus*, but they correspond very closely with *Alpheus avarus* of this Report and *Alpheus strenuus* and *Alpheus parvirostris* of Dana.

It moreover appears that in a genus so generally distributed as *Alpheus*, a specific character that is largely dependent upon the form of one abnormally developed appendage must be very untrustworthy as a natural distinction of species, inasmuch as the tendency to vary in that organ must be great.

[1] See de Haan, in Siebold's Fauna Japonica, p. 179, pl. xlv. fig. 3.

Alpheus avarus, Fabricius (Pl. CI. fig. 1).

Alpheus avarus, Fabricius, Suppl. Entom. Syst., p. 404.
„ „ de Haan, in Siebold's Fauna Japonica, Crust., p. 179 (*bis-incisus*) pl. xlv. fig. 3.
„ „ Heller, Reise der Novara, Crust. p. 108.
Palæmon brevirostris, Olivier, Encycl., tom. viii. p. 664, pl. cccxix. fig. 4.
Alpheus parvirostris, Dana, U.S. Explor. Exped., Crust., p. 551, pl. xxxv. fig. 30.
„ *brevirostis*, Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 350.
„ *doris*, White, List. Brit. Crust., p. 75, 1847.
„ *strenuus*, Dana, U.S. Explor. Exped., Crust., p. 543, pl. xxxiv. fig. 4, 1852.
„ *strenuus*, Miers, Ross's Voyage of the "Erebus" and "Terror," Crust., p. 5, 1874.
„ *doris*, White, Ross's Voyage of the "Erebus" and "Terror," Crust., tab. 4, fig. 2, 1873.

This species was first described by Fabricius and again by de Haan. The latter has figured it under the name of *Alpheus bis-incisus* on the plate but corrected it in the text to *Alpheus avarus*.

It appears to differ very little from the species that I have figured as *Alpheus edwardsii* from Cape Verde Islands, and which corresponds very closely with the figure of *Athanas edwardsii* given by Audouin. With the specimens of the two species before me, the only variation between them that I can detect is that in *Alpheus avarus* the larger hand is horizontally grooved on each side from the notch on the upper surface, whereas in *Alpheus edwardsii* it is on the outer side only, and the prominence behind the same notch in *Alpheus edwardsii* is less in the form of a tooth than in *Alpheus avarus*.

Milne-Edwards says that *Alpheus avarus* is probably identical with *Alpheus brevirostris*, Olivier, and according to his description there is nothing to distinguish between them.

Among the specimens that I think may be attributed to this species is one from Torres Strait, which very closely agrees with the description, so far as it goes, of a species given by Dana under the name of *Alpheus acuto-femoratus*, as shown on the next page.

Length, entire,	22 mm. (0·8 in.)
„ of carapace,	8 „
„ of pleon,	14 „
„ of large hand,	12 „
„ of dactylos of large hand,	4 „
„ of small hand,	8 „
„ of dactylos of small hand,	4 „
„ of telson,	4 „

Habitat.—Arafura Sea; Albany Island, Cape York.

Station 172, June 22, 1874; lat. 20° 58′ S., long. 175° 9′ W.; off Nukalofa, Tongatabu; depth, 18 fathoms; bottom, coral mud. Two specimens, males (?). Dredged.

Station 234, June 3, 1875; lat. 32° 31′ N., long. 135° 39′ E.; off Japan; depth, 2675 fathoms; bottom, blue mud; bottom temperature, 35°·8. One specimen, female.

Milne-Edwards records his species from New Holland, and de Haan his from Japan.

Observations.—The specimen from Station 234, which was laden with ova, has lost the chelæ, but agrees in all other respects with the other specimens. As is often the case it is rather more robust than the male.

Some drawings of what appears to be this species, in Sir Walter Elliot's collection, show the variability of colour. One is beautifully marked with cream-coloured spots on a general ground of red, with deeper dots of the same. Another is a dark olive-green, dark on the back and shading to buff on the claws.

Alpheus acuto-femoratus, Dana (Pl. XCVII. fig. 2).

Alpheus acuto-femoratus, Dana, U.S. Explor. Exped., Crust., p. 550, pl. xxxvi. fig. 2.

Carapace anteriorly produced to a sharp-pointed rostrum, with a longitudinal groove on each side, separating it from the orbital lobes, which are anteriorly produced to a very small point.

The first pair of antennæ carries a stylocerite that is about half the length of the first joint of the peduncle, and terminates in two flagella that are slightly longer than the peduncle; the shorter is the more robust, and it exhibits a tendency to a bifid termination, one branch being short and the other abruptly truncate.

The second pair carries the rudiment of a tooth on the basal joint, and supports a scaphocerite that is subequal in length with the peduncle of the first pair.

The first pair of pereiopoda is asymmetrical, that on the left being the larger, resembling closely in form that of *Alpheus avarus* and *Alpheus edwardsii;* that on the left also resembles the same limb in *Alpheus edwardsii*, but has the fingers of the chela somewhat shorter. The second pair of pereiopoda is longer than the third, and the first joint of the carpos is longer than the second.

Length, 21 mm. (0·8 in.).

Habitat.—Station 186, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E., between Cape York and the Arrou Islands; depth, 8 fathoms; bottom, coral mud. Dredged.

Observations.—Dana says of his species—"Length nine lines. The hands of the specimen are gone, and we are not sure that the species should not be in the preceding division" ("*a* Orbitæ margo inermis," instead of in "*b* Orbitæ margo spinula denteve armatus," where he places it), "although its general characters are more like those in which the lower margin of the hand is straight, it is peculiar in having a spine at the apex of both the second and third joints of the third and fourth pairs of legs, the fifth pair of legs is more narrow than the fourth." A drawing taken from the living animal, in the late

Sir Walter Elliot's collection, from a specimen obtained at Waltair on the coast of Madras, which corresponds with this form, shows the animal to be of an orange colour with a broad dark crimson stripe on each side of the median line from head to tail, and one across the rhipidura.

Alpheus cristidigitus, n. sp. (Pl. XCVII. fig. 3).

Carapace having a slender rostrum. Orbital lobes dorsally elevated above the median crest and armed anteriorly with a small tooth that does not reach so far as the apex of the rostrum.

The first pair of antennæ has the upper branch but little longer than the peduncle, robust, truncate, without any slender terminal flagellum. The lower branch is slender and much longer than the upper, being two-thirds the length of the animal. The stylocerite is broad, flat, and tipped with a minute, slender, sharp tooth.

The second pair of antennæ is as long as the animal, and supports a scaphocerite that reaches to the extremity of the peduncle.

The first pair of pereiopoda is very unequal, the right being the greater in most of our specimens, and is very large and irregular in form. The propodos is rather more than half the length of the animal, it has a deep notch on the upper surface and a corresponding one on the lower, at the base of the dactylos; on the upper margin there is a sharp tooth, and a second and stronger one is placed a little posterior to it. The dactylos is broad, obtuse, obliquely articulated, and only one-fourth the length of the palm. The left (fig. 3*k*) has the propodos about two-thirds the length of the right, and has a notch on the upper and lower margins opposite to each other; on the upper side anterior to the notch, close behind the dactyloid articulation, is a strongly projecting tooth or sharp angle; the pollex is straight and smooth, the dactylos is straight on the inner or proximal margin and arched on the outer side, on which a thin marginal crest is continuous from the base to the apex. This crest is so peculiar, that I have derived the specific name of the animal from it. The second pair of pereiopoda is slender; the third and fourth pairs have the meros armed with a strong tooth on the lower distal angle.

The fifth pair is more slender and shorter than the preceding, has no tooth on the meros, and terminates in a simple, pointed dactylos, resembling those of the two preceding pairs.

The pleopoda are slender and the telson is broad, slightly tapering, distally rounded, fringed with hairs, and armed on the dorsal surface with two small equidistant spines on each side of the median line.

Length, entire,	10 mm. (0·4 in.).
„ of carapace,	4 „
„ of pleon,	6 „
„ of large hand,	7 „
„ of dactylos of large hand,	1 „
„ of small hand,	4 „
„ of dactylos of small hand,	2 „
„ of telson,	1·5 „

Habitat.—Station 93c, July 27, 1873; lat. 16° 57′ 15″ N., long. 25° 1′ W., St. Vincent, Cape Verde Islands; depth, 52 fathoms; bottom, coralline mud. Nineteen specimens; ten females bearing ova, and nine males.

Observations.—This species was found with *Alpheus edwardsii*, and when mingled with the younger forms, required close observation to be distinguished from them. It bears a close resemblance to *Alpheus megacheles*, Hailstone, from the English Channel, and which the Rev. Canon Norman states to be *Alpheus edwardsii*, Milne-Edwards. It differs, however, from the British form, in having a strong tooth on the meros of the third and fourth pairs of pereiopoda. The large chela is very similar, and has the dactylos impinging obliquely against the pollex; but there is a deeply incised notch in the upper and lower margins, which in *Alpheus megacheles* (Pl. XCVII. fig. 4) are smooth. The smaller chela has also a peculiar resemblance in general form, but possesses a narrow crest on the upper surface of the dactylos, which is wanting in the British species. The largest specimen that we have of *Alpheus cristidigitus* is only 10 mm. in length; and they are undoubtedly mature, since the females are laden with ova. *Alpheus megacheles* on the other hand is 50 mm. long; but this may not necessarily be a specific feature, as specimens of *Alpheus edwardsii*, quite as small as *Alpheus cristidigitus*, were found associated, also having ova attached.

Alpheus bermudensis, n. sp. (Pl. XCVIII. fig. 3).

Rostrum short, slightly depressed anteriorly, forming a carina that extends posteriorly as far as the orbital lobes, and separated from them by a small groove. Fronto-orbital margin produced to a blunt point that reaches nearly to the extremity of the rostrum.

First pair of antennæ having the first joint of the peduncle not longer than the extremity of the rostrum, the second joint about the same length as the first, and the third shorter than the second. The stylocerite is flat and pointed, reaching nearly as far as the end of the first joint. The flagella are unequal, the upper branch being about the same length as the peduncle, and the lower being about two-thirds that of the whole animal.

Second pair of antennæ having a scaphocerite that is a little longer than the peduncle of the first pair.

First pair of pereiopoda having the larger hand broad and long, obliquely attached and laterally compressed, the upper margin indented a little behind the dactylar hinge, from which indentation a longitudinal groove runs back on the inner and outer sides and gradually dies out towards the posterior or carpal extremity. The hand upon the left side is broken off in all the specimens in the collection. The four following pairs are also wanting in our type specimen, but in the others they exhibit no specially noticeable feature.

The telson is short, broad and ovate at its posterior extremity, which is fringed with hairs.

	Female.	Male.
Length, entire,	22 mm. (0·8 in.).	19 mm. (0·7 in.).
„ of carapace,	7 „	6·5 „
„ of pleon,	15 „	12·5 „
„ of large chela,	...	9 „
„ of dactylos of large chela,	...	4 „
„ of telson,	3·5 „	2·5 „

Habitat.—Bermuda, shallow water. Three specimens; one male and two females of which one bears mature ova.

St Thomas, West Indies. A damaged female, laden with ova, which appears to belong to this species.

Observations.—I cannot identify this form with any species known from the western shores of the Atlantic, or with any in Kingsley's Synopsis of the North American Species, but it corresponds with *Alpheus avarus* of Fabricius more nearly than with any other form. The female specimen, which is laden with ova, has lost both its chelæ; it is longer and stouter than the others.

Alpheus crinitus, Dana (Pl. XCVIII. fig. 2).

Alpheus crinitus, Dana, U.S. Explor. Exped., Crust., p. 548, pl. xxxiv. fig. 8, *a-f*.

Rostrum short, scarcely reaching beyond the orbital lobes, which are prominent but without frontal teeth.

First pair of antennæ having the three joints of the peduncle subequally short, upper flagellum not longer than the peduncle, the lower being a little longer and more slender than the upper.

Second pair of antennæ having the peduncle a little longer than that of the first, and the outer tooth of the scaphocerite quite as long.

Second pair of gnathopoda reaching as far as the distal extremity of the peduncle of the second pair of antennæ.

First pair of pereiopoda having the right hand very long, thick, smooth, and pear-shaped, tapering towards the dactylos. The pollex is shorter than the dactylos which is curved and obtusely pointed, the entire hand being about two-thirds the length of the animal.

	Female.	Male.
Length, entire,	18 mm. (0·7 in.).	11 mm. (0·4 in.).
„ of carapace,	6 „	4 „
„ of pleon,	12 „	7 „
„ of telson,	2·5 „	1·5 „
„ of large chela,	6 „	6·5 „

Habitat.—Samboangan, Philippine Islands; reefs. One specimen, male.

Station 208.—January 17, 1875; lat. 11° 37′ N., long. 123° 31′ E.; off Manila; depth, 18 fathoms; bottom, blue mud. One specimen, female. Trawled.

Observations.—The specimen taken at Station 208 was a female, in which the large hand was relatively small; it was laden with ova of a pale yellow or lemon colour, and was associated with a specimen of *Alpheus spiniger* (Stimpson).

It corresponds very closely in general appearance with *Alpheus minus*, Say, but it has no tooth on the orbital lobes. However, if Kingsley be correct (and I think we require more extensive experience in our knowledge of these animals before deciding) in determining that these orbital teeth are of no specific value, the separation of this form from *Alpheus minus* becomes more difficult. It has, however, a more robust carpos and propodos on the third and fourth pairs of pereiopoda, carries a tooth on the under or posterior angle of the meros, has the propodos fringed with long spines, and the dactylos tipped with a small secondary unguis.

Alpheus leviusculus, var., Dana (Pl. XCVIII. fig. 1).

Alpheus edwardsii, var. *leviusculus*, Dana, U.S. Explor. Exped., Crust., p. 543, pl. xxxiv. fig. 3.

Carapace about one-third the length of the animal; anterior dorsal surface elevated over the gastric region, and produced anteriorly to a rostrum that is separated from the orbital lobes by a slight longitudinal groove. Orbital lobes without a tooth, but the angle on the inner side projects slightly, so that when held in some positions there appears to be a small tooth.

First pair of antennæ pubescent and having the second joint twice the length of the first, the stylocerite broad, flat, pointed, and as long as the first joint. Flagella subequal; the inner, which is the more slender, is about as long as the carapace.

The second pair has a scaphocerite that is rather longer than the peduncle, and terminates in a sharp point which is separated for a short distance from the foliaceous portion.

The second pair of gnathopoda is slender and short, not reaching beyond the extremity of the peduncle of the second pair of antennæ.

The first pair of pereiopoda has the large chela on the right side in our solitary specimen; it is about as long as the carapace and about three times as long as broad; the upper surface has a slight depression behind the dactyloid articulation on the inner, outer and inferior surfaces, and is continued longitudinally backwards near the middle of the outer surface, where it gradually dies out. The smaller chela is wanting. The second pair has the two first articuli of the carpos subequal and together longer than the three succeeding. The following pairs have the dactylos long and single-jointed.

Telson broad, slightly tapering, terminal margin rounded, having a small spine at each angle, and the margin fringed with hairs; dorsal surface armed with two small spines on each side.

Length, entire,	32 mm. (1·2 in.).
„ of carapace,	11 „
Depth of carapace,	9 „
Length of pleon,	21 „
„ of large chela,	10 „
„ of dactylos,	4 „

Habitat.—Station 203, October 31, 1874; lat. 11° 6′ N.; long. 123° 9′ E.; off Panay, Philippine Islands; depth, 20 fathoms; bottom, mud. One specimen; female, laden with ova. Trawled.

Observations.—This specimen corresponds very closely with Dana's figure and description of *Alpheus leviusculus*, but differs in having the great chela somewhat narrower in proportion (figs. 1*k*, 1*k*″), and the depression on the propodos behind the dactyloid articulation is less decided. In the second pair of pereiopoda the articuli also vary a little, the second articulus being nearly as long as the first, whereas Dana says that "the first is hardly as long as the second, and thin," although his figure does not show such decided variation. His specimen was taken off Wakes Island in the North Pacific, and ours at the Philippine Islands. I therefore consider this specimen to be only a variety of Dana's species, and retain for it the same name as that proposed by the distinguished American carcinologist. He, however, considers his species as being only a variety of the specimens of *Alpheus edwardsii* which he took off the Cape Verde Islands in the Atlantic. He also says—"It is near the *A.* 2-*incisus* of de Haan, which de Haan considers a variety of *A. avarus* of Fabricius." Dana also remarks that "the large hand is proportionately narrower, but this is often a varying character in the same species."

Alpheus longimanus, n. sp. (Pl. XCVIII. fig. 4).

Rostrum narrow and sharp pointed. Orbital lobes prominent but not pointed.

First pair of antennæ with the stylocerite broad, flat and disc-like, anteriorly produced to a small, sharp pointed tooth; the second joint of the peduncle is longer than the first, and the third is shorter and terminates in two flagella, the longest of which is about two-thirds the length of the body of the animal.

The second pair of antennæ carries a very minute tooth at the base, and a scaphocerite that reaches as far as the extremity of the peduncle of the first pair of antennæ, but scarcely as far as that of the second pair.

The first pair of pereiopoda is unequal on the two sides; the larger, which is generally on the right side, has the margins nearly parallel until near the base of the dactylos, where a constriction takes place so as to form a tooth above and below.

The pollex is produced anteriorly and curved at the point, the lateral margins being elevated in the form of cusps that form a hollow or spoon-like space between them, into which a blunt tooth or protuberance on the inner surface of the dactylos projects. The smaller hand is long, slender, and subcylindrical, the fingers being nearly, and in some instances quite, as long as the propodos.

Length, entire,	44 mm. (1·7 in.).
„ of carapace,	14 „
Depth of carapace,	10 „
Length of pleon,	30 „
„ of large chela,	20 „
„ of dactylos of large chela,	7 „
„ of small chela,	18 „
„ of dactylos of small chela,	9 „

Habitat.—Off Yokoska, Japan, in from 5 to 20 fathoms. Four females, bearing ova.

Stations 233, 233A, May 17, 19, 1875; off Kobé, Japan; depth, 8 to 50 fathoms; bottom, sand and mud. Four specimens; two males, one female, and one young. Dredged.

The body of the animal is generally robust, smooth, and even, having no groove or carina on the dorsal surface of the carapace, except a small depression between the orbital lobes and the rostrum, and another at the frontal margin external to the orbital lobes (fig. 4c).

The first pair of antennæ has the first joint about the length of the rostrum and supports an oval scaphocerite, tipped with a small tooth; the second rather longer than the first, and the third about half the length of the second; the flagella are very unequal, the shorter and more robust is a little longer than the peduncle, the stouter portion being produced to a rudimentary second branch, while the more slender flagellum is nearly as long as the body of the animal.

The second pair of antennæ (fig. 4*c*) has the peduncle a little longer than that of the first, the basal tooth is very small and unimportant, and the scaphocerite has the squamous plate continuous with the outer margin to near the distal extremity, where it terminates in a sharp tooth; the flagellum of this pair of antennæ is delicately slender and longer than the entire animal. The second pair of gnathopoda extends to a little beyond the peduncle of the second antennæ, and carries a branch that reaches to the distal extremity of the antepenultimate joint.

The first pair of pereiopoda (figs 4*k*, 4*k'*) is long and unequal on the two sides; the larger being sometimes on one side, sometimes on the other. The meros of the larger hand is produced to a point on the upper distal angle and is fringed with hairs. The carpos is triangular and produced anteriorly above and below. The propodos is long and flattened on each side, the upper and lower margins being nearly parallel; a short distance behind the articulation of the dactylos there is a deep and receding notch, which brings about the formation of a sharp pointed tooth-like process behind it; in a corresponding position on the lower margin there is a similar tooth-like process. The pollex is directed horizontally forward and has the margin on each side elevated into a ridge, between which the edge of the dactylos, which is furnished with a blunt tuberculose tooth, impinges. The left hand (fig. 4*k'*) is long, narrow, and nearly cylindrical, being slightly compressed laterally; the fingers are about as long as the palm. In the specimen which, from being the most perfect, I have selected as the type, and from which I have taken the figures, the fingers are not so long as they are in some of the other specimens.

The second pair of pereiopoda has the carpos six-articulate, the first articulus being a little longer than the second, and the two equal to half the carpos.

In the Bay of Bengal, off Waltair, on the coast of Madras, a species was taken by the late Sir Walter Elliot that resembles this in all respects, except in the presence of the deep notch on the upper and lower margins.

Alpheus rapax, Fabricius (Pl. XCIX. fig. 1).

Alpheus rapax, Fabricius, Suppl. Entom. Syst., p. 404.
„ „ Milne-Edwards, Hist. Nat. Crust., t. ii. p. 353.
„ „ de Haan, in Siebold's Fauna Japonica, Crust., p. 177, tab. xlv. fig. 2.

Rostrum reaching nearly to the extremity of the first joint of the peduncle of the first pair of antennæ, laterally compressed, producing a small carina that extends backwards and fades away on the gastric region. Orbital lobes separated from the dorsal carina by a deep groove.

The first pair of antennæ has the stylocerite short, flat, and broad, with a small tooth at the anterior extremity, which reaches nearly to the end of the first joint; the second

joint is three times as long as the first, and the third is about one-fourth the length of the second. The flagella are very unequal, the upper being stout and about the length of the peduncle, the lower slender and about two-thirds the length of the animal.

The second pair of antennæ has the inferior tooth at the base very short, and the scaphocerite pointed and a little longer than the peduncle of the upper pair, and terminates in a flagellum which is half as long again as the entire animal.

The first pair of pereiopoda is asymmetrical. In our specimen that on the right is the smaller. It has the palm of the propodos short, and the pollex and dactylos long, slender, and gaping, thickly fringed with long hairs on the inner and outer margins, on which they extend back nearly to the carpal articulation; the meros is furnished at the upper anterior angle with a small tooth; the left hand is not much longer than the right, but has the propodos long and the dactylos short; the extremities of pollex and dactylos are abruptly curved to meet each other; the carpos is short and the meros is armed with a small tooth at the antero-superior angle. The second pair of pereiopoda has the carpos five-articulate; the first two articuli are subequally long, the three following are subequally short, as also is the terminal minute chela. The third and fourth pairs of pereiopoda have the meros long and broad, whereas that of the fifth pair is slender and not quite so long.

The rhipidura is well developed, having the lateral plates longer than the telson, which has the distal angles furnished with a small spine, and two others placed longitudinally on the dorsal surface on each side of the median line, subequally distant from the anterior and posterior extremities, the latter of which is fringed with long hairs.

Length, entire,	39 mm. (1·5 in.).
„ of carapace,	14 „
Depth of carapace,	8 „
Length of pleon,	25 „
„ of large chela,	19 „
„ dactylos of large chela,	7 „
„ small chela,	17 „
„ dactylos of small chela,	12 „
„ telson,	5 „

Habitat.—Hong Kong, at a depth of about 10 fathoms. One specimen, male.

Judging by the description of Milne-Edwards I have little doubt that this species is *Alpheus rapax* of Fabricius, but the figure given by de Haan exhibits markings on the outer side of the great chela that are scarcely consistent with the following, which he quotes from Fabricius—"Manu majore compressa lævi digitis brevibus;" and de Haan also says of his own specimen—"Manus majoris subparallelæ latere externo bicostato," and figures it with longitudinal ribs; it differs, apparently, only in degree from that of *Alpheus malabaricus*, Fabr. (*brevicristatus*) in his pl. xlv. fig. 1.

The late Sir Walter Elliot, S.I., obtained a specimen at Waltair, near Madras, which, so far as I could determine from a well-executed drawing, resembles this in every detail. He says in his notes that in the living state the colour on the back is green, and that on the large pair of legs blue, mottled with white spots, the claws being tipped with yellow; the three pairs of pereiopoda are also blue, and the long pair of antennæ, which is one and a half times the length of the body, measured from the base of the first joint to the end of the tail, is also bluish.

Alpheus crassimanus, Heller (Pl. XCIX. fig. 2).

Alpheus crassimanus, Heller, Reise der Novara, Crust., p. 107, pl. x. fig. 2.

Rostrum short, spiniform, anteriorly depressed; separated by a groove on each side from the orbital lobes, which are prominently developed.

First pair of antennæ having the second joint of the peduncle longer than the first, with the stylocerite reaching to the extremity of the first joint. Flagella unequal, the upper and more robust being as long as the peduncle, the lower and more slender as long as the carapace.

Second pair of antennæ having a small tooth at the base and a scaphocerite that is as long as the peduncle.

First pair of pereiopoda having the larger hand upon the left side, the upper and lower margins being slightly constricted, the former close behind the dactyloid articulation and the latter still more posteriorly. The pollex is broad, flattened, internally concave and produced anteriorly to a lanceolate point. Dactylos broad and flat, lanceolate in form, constricted posteriorly, broadly ribbed down the centre, and pointed anteriorly in the form of a curved tooth; the outer margin is thickly fringed with cilia. The right or smaller hand is wanting, nor is it figured by Heller, but he describes it in the male as being "half the size of the other, having the palm a little compressed and sinuated on both margins near the apex. Fingers scarcely shorter than the palm."

The second and following pairs of pereiopoda rather long; the fifth pair more slender than the third and fourth.

Length, entire,	20 mm. (0·8 in.).
,, of carapace,	7 ,,
,, of pleon,	13 ,,
,, of large chela,	7 ,,
,, of dactylos,	3 ,,

Habitat.—Off Albany Island, near Cape York; depth not given.

Heller records his specimen as having been found at the Nicobar Islands.

Observations.—There can, I think, be little doubt that the specimen which I figure belongs to the same species as that described by Heller as *Alpheus crassimanus*.

The only distinction that I can determine is that in the Challenger specimen, the dactylos of the great chela terminates in a long, slightly curved, tooth-like projection, attached not at the apex but on the under surface near the margin. It may be that it gets worn off by use, or it may have been so hidden in Heller's specimen by the hirsute margin that it escaped notice, as it did in this specimen for some time.

Alpheus lævis, Randall (Pl. XCIX. fig. 3).

Alpheus lævis, Randall, Journ. Acad. Nat. Sci. Philad., vol. viii. p. 141.
„ „ Dana, U.S. Explor. Exped., Crust., p. 556, pl. xxxv. fig. 8.
„ „ Heller, Reise der Novara, Crust., p. 107.

Rostrum spiniform, reaching to nearly the extremity of the first joint of the peduncle of the first pair of antennæ, and separated from the orbital lobes by a deep fissure on each side. Orbital lobes prominent and armed with a small tooth on the frontal margin.

First pair of antennæ furnished with a stylocerite that reaches beyond the extremity of the first joint of the peduncle, and to nearly the middle of the second; second joint scarcely longer than the first, third shorter than the second. The flagella are short, the upper being about the length of the peduncle, and the lower about twice the length of the upper.

Second pair of antennæ having the tooth at the base moderately long, and the scaphocerite as long as the peduncle of the first pair, but scarcely so long as that of the second; the flagellum is about half the length of the animal.

First pair of pereiopoda subequal on the two sides, both being smooth and compressed, that on the left side having the dactylos shorter than that on the right, and armed at the dactyloid articulation with two blunt teeth, whereas that on the right has none. Second pair of pereiopoda a little longer than the third, and having the second articulus of the carpos subequal with the first, which is rather the longer. The third and fourth pairs of pereiopoda have the meros broad and long, and the carpos and propodos stout and short, the latter being armed on the posterior margin with short spines. The fifth pair is broken, but from the remnant it appears to be more slender than the preceding.

Telson slightly tapering, with two spines on the dorsal surface, on each side of the median line; posterior margin rounded and fringed with long hairs, and armed at the outer angles with a small spine.

Length, entire,	25 mm. (1 in.).
„ of carapace,	7 „
Depth of carapace,	7 „
Length of large chela,	14 „
„ of small chela,	13 „

Habitat.—Honolulu, reefs. One specimen; male.

Dana obtained his specimens from the Sandwich Islands, and also from the Fiji Group, and Heller records it from the Nicobar Islands, Sydney and Tahiti.

Observations.—This species is undoubtedly *Alpheus lævis*, Randall, as figured and described by Dana. In our specimen the left hand is broken off, but one found in the bottle agrees with the figure in Dana's plates, and if it belongs to our specimen the left hand is rather larger than the right, being 14 mm. long, while the right is 13 mm.; in width the right is 5 mm., and the left 7 mm. The detached limb, although it has the character of being from the left side, and corresponds with Dana's figure, may be that of a second specimen, but as there was no other in the bottle to which it could belong, I believe it to have dropped from this one, and so describe it, having, however, figured it detached (fig. 3*k*). Each of them has the upper surface covered with small spots, and a number of short hairs.

On the branchial region of the carapace, corresponding with the upper extremity of the branchial chamber, a series of capillary vessels are seen within a circular margin of transparent tissue (fig. 3*c*).

Alpheus prolificus, n. sp. (Pl. XCIX. fig. 4).

Carapace two-thirds of the length of the pleon. The rostrum narrow. The orbital lobes pointed, broad, and nearly equal in length to the rostrum.

First pair of antennæ having the second joint of the peduncle shorter than the first, the third subequal with the second. Stylocerite a little longer than the first joint, flagella subequal and about as long as the carapace.

Second pair of antennæ as long as the animal, peduncle longer than that of the first pair, basal tooth as long as the stylocerite and nearly half as long as the scaphocerite, which is subequal with the peduncle.

First pair of pereiopoda lost. Second slender, having the carpos five-articulate, the first articulus being longer than the four following ones. Third and fourth pairs robust, meros broad, compressed, without distal tooth; carpos anteriorly produced on the upper distal margin; propodos curved, furnished with spines on the posterior margin; dactylos stout, bluntly pointed, with a small secondary unguis on the outer surface (fig. 4*m*).

The pleopoda are broad and foliaceous.

Telson broad, smooth, furnished with two spinules on the dorso-lateral surface, tapering and rounded at the extremity.

Length, entire,	20	mm. (0·8 in.).
„ of carapace,	8	„
Depth of carapace,	5·5	„
Length of pleon,	12	„

Habitat.—Off Honolulu, Sandwich Islands; depth, 18 fathoms. One specimen; female.

Observations.—This species is one of those that approach *Alpheus neptunus*, Dana (Pl. CI. fig. 2), and *Alpheus biunguiculatus*, Stimpson. It differs from the former in having the carpos of the third and fourth pairs of legs anteriorly produced at the upper distal extremity, and in having the dactylos biunguiculate, and from the latter (Pl. CI. fig. 4) in being generally more robust, in having the rostrum and supraorbital teeth less prominent, the carpos of the third pair of pereiopoda produced on the upper margin, and the dactylos short and thick, the second unguis being rudimentary and situated behind the larger on the outer margin.

Our specimen is a female and carries a very large mass of ova, which are oval; hence the specific name.

Alpheus intrinsecus, n. sp. (Pl. C. fig. 1).

Dorsal surface arched from the frontal margin of the carapace to the telson. Carapace and pleon smooth. Rostrum reaching to the extremity of the first joint of the first pair of antennæ. A sulcus separates the rostrum from the orbital lobes, which are armed with a sharp tooth on the inner dorsal surface.

The first pair of antennæ has the first joint armed with a stylocerite that is broad, sharp pointed, and reaching to the extremity of the first joint, which is hollowed on the upper surface and furnished with a small bunch of hair. The terminal flagella are unequal in length and size, the inner one being nearly as long as the animal.

The second pair of antennæ has a scaphocerite that reaches to the distal extremity of the peduncle of the first pair of antennæ, terminates in a sharp rigid point united to the inner squamous part nearly as far as the extremity, towards which it gradually narrows from the base; at the extremity of the previous joint is a sharp but not long tooth. The terminal joint of the peduncle reaches as far as that of the first pair, and carries a flagellum twice the length of the animal.

The first pair of pereiopoda is unequal, that on the left side (fig. 1*k*) being the smaller and more normal. It has the meros long and not excavated to receive the posterior lobe of the carpos, and is crenated along the lower margin; carpos long, triangular; propodos long and narrow, scarcely broader than the anterior diameter of the preceding joint; dactylos resembling the pollex, being long, straight, and slightly curved at the distal extremity. That on the right side has the meros slightly excavated to receive the posterior lobe of the carpos; carpos short, broader than long, propodos large and wide, armed with a tooth on the upper surface, with a sulcus anterior to it, and two small sharp teeth, one on each side of the dactyloid articulation; on the lower margin, corresponding in position, are two

other small teeth or points, and in front of them a sulcus that unites faintly with the one on the upper side. The pollex is sharp pointed and curved upwards towards the anterior extremity; the dactylos is broad, arcuate, obtuse at the point and furnished posteriorly with a large tubercle, that corresponds with a deep notch in the posterior portion of the pollex. The second pair of pereiopoda has the carpos six-articulate. The three posterior pairs are subequal, the last being but slightly more slender than the preceding two pairs, and has the propodos fringed with small spines.

The pleopoda are long and slender, and carry in the female a large number of small round ova.

The posterior pair of pleopoda forms the lateral plates of the rhipidura. The outer margin of the outer plate is rigid, and terminates in two small teeth, the space between them being occupied by a spine; the diæresis is well defined, and the terminal portion of the plate is broad and short; the inner plate is terminally rounded, and both are distally fringed with long plumose hairs.

The telson is long and tapers to the distal extremity, it is armed on the dorsal surface with two short spines on each side of the median line; the terminal margin is convex, armed at each corner with a small spine and fringed with long and ciliated hairs.

Length, entire,	28	mm. (1·1 in.).
„ of carapace,	10	„
Depth of carapace,	8	„
Length of rostrum,	1	„
„ of pleon,	18	„
„ of sixth somite of pleon,	2·5	„
„ of telson,	4	„
„ of large chela,	13	„
„ of dactylos of large chela,	5	„
„ of small chela,	10	„
„ of dactylos of small chela,	6	„

Habitat.—Off Bahia; in from 7 to 20 fathoms. One specimen; female, laden with ova.

Alpheus minus, Say (Pl. C. fig. 2).

Alpheus minus, Say, Journ. Acad. Nat. Sci. Philad., vol. i. p. 245, 1818.
„ „ Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 356.
„ „ Kingsley, Bull. U.S. Geol. Survey, p. 190, 1878.

Carapace anteriorly produced to a sharp pointed rostrum that reaches to about the extremity of the first joint of the peduncle of the first pair of antennæ. Orbital margin anteriorly produced to a point subequal with the rostrum.

First pair of antennæ rather longer than the carapace.

First pair of pereiopoda unequal, the larger pair long, ovate, and the smaller elongate. Three posterior pairs of pereiopoda triangulate.

Length, entire,	14 mm. (0·5 in.).
„ of carapace,	6 „
Depth of carapace,	4 „
Length of pleon,	8 „
„ of telson,	3 „
„ of large chela,	9 „
„ of dactylos of large chela,	3 „
„ of small chela,	3 „
„ of dactylos of small chela,	1 „

Habitat.—Off Bahia. Three specimens; one female, two males.

Station 113A, September 2, 1873; lat. 3° 47′ 0″ S., long. 32° 24′ 30″ W.; off Fernando Noronha; depth, 7 to 25 fathoms; bottom, volcanic sand and gravel. One specimen, female (6 mm. long), with ova. This specimen has lost its longer chela.

St. Paul's Rocks, the Atlantic. Two specimens, females (9 mm. long), from which ova had just been cast.

This species appears to be common in the tropical and temperate regions of the Atlantic Ocean from Bermuda in the north to St Paul's Rocks in the south.

Observations.—Kingsley in his full description of this species says that the larger hand has "a strong spine (tooth) above, and a smaller one near it at the articulation of the dactylos." I only saw this tooth conspicuously developed in one specimen. As a rule it is not a specific character, as in a great number of specimens of this and other species a tooth normally exists at the dactyloid hinge, but it is frequently rudimentary or rubbed down by use.

The same author also says that "in some specimens the ocular spines are wanting; in others the point is truncate, no spines being present. The proportions of the joints of the carpos of the second pair also vary."

"The relative length of the rostrum and ocular spines can be of no great importance when they vary as I have shown." He says, moreover, that he was not able to separate specimens from Pearl Island, Bay of Panama, from Floridan examples. "The antennular spines also are not incurved. Other than these I can detect no important points of difference."

One peculiarity has been overlooked by previous observers, namely, that the dactylos has an extremely long and robust tubercle projecting posteriorly, and generally lying inserted in a circular hollow in the median line at the base of the pollex; anterior to this tubercle is a second smaller one. The posterior projecting tubercle is common to many species, but in this it is remarkable for its length.

With reference to this species Mr. J. S. Kingsley further remarks,[1] "In the Annual Report of the U. S. Geological and Geographical Surveys of the Territories for 1874, p. 388, Mr. Ernest Ingersoll says—'From the pond mentioned, between camps E. and F. [in south-western Colorado] a small crab was brought home, which Professor I. S. Smith pronounced to be a true marine form, belonging to the Astacidoæ (sic).' Professor Smith informs me that the specimen shown to him was undoubtedly *Alpheus minus*, and thought it more than probable that some confusion of localities or mixture of specimens had occurred, but, on the other hand, Mr. Ingersoll is as positive as it is possible to be that the specimen was found in the pond mentioned."

Alpheus spiniger, Stimpson (Pl. C. fig. 3).

Alpheus spiniger, Stimpson, Proc. Acad. Nat. Sci. Philad., p. 110, January 1860.

Body robust, coxal plates of the pleon as deep as the lateral walls of the carapace, rostrum acute, straight, reaching beyond the first joint of the peduncle of the first pair of antennæ, and separated by a groove on each side from the orbital lobes, which are armed with a sharp and straight tooth that is about half the length of the rostrum.

First pair of antennæ having the first joint a little longer than the second, and furnished with a stylocerite that is equal to it in length. The flagella are subequal, neither being much longer than the peduncle.

The second pair of antennæ has the basal tooth reaching nearly as far as the extremity of the rostrum, and the scaphocerite as long as the peduncle of the first pair.

The second pair of gnathopoda has the terminal joint extending beyond the peduncle of the second pair of antennæ, and has the margins fringed with hairs.

The first pair of pereiopoda (figs. 3*k*, 3*k'*) has the larger hand upon the right side; carpos small; propodos ovate, smooth, thick and tapering; pollex hollowed, with the lateral margins elevated; dactylos rounded at the apex and posteriorly produced on the inner side to a stout tubercle, which, when the hand is closed, is impacted deeply into a cavity at the posterior extremity of the pollex. The smaller or left chela (fig. 3*k'*) is normal in form and much resembles that of a species of Brachyura; it has the pollex and dactylos slightly curved, closely impinging, parallel, and about half the length of the palm. The second pair of pereiopoda is not much longer than the third, it has the four distal articuli of the carpos subequal in length, and the first nearly as long as the other four. The third, fourth and fifth pairs are subequally robust, the anterior being the most and the posterior the least so. The carpos has the upper distal angle produced to a blunt tooth or process, which is most conspicuous on the anterior pair and least so on the posterior. The propodos is slightly curved and

[1] *Proc. Acad. Nat. Sci. Philad.*, p. 14, August 1878.

free from spines, but furnished with a few hairs towards the distal extremity. Dactylos biunguiculate, most conspicuously so on the anterior pair.

Telson (fig. 3z) shorter than the outer plates of the rhipidura; broad at the base and evenly tapering to the posterior margin, where it is truncate and armed with two small spines at the outer angles. There are no spines on the dorsal surface, which is quite smooth and grooved in the median line.

Length, entire,	18 mm. (0·7 in.)
„ of carapace,	7 „
Depth of carapace,	4 „
Length of pleon,	11 „
„ of telson,	3 „

Habitat.—Station 208, January 17, 1875; lat. 11° 37′ N., long. 123° 31′ E.; off Manila; depth, 18 fathoms; bottom, blue mud. One specimen; female, with ova. Trawled.

The specimen from which we have drawn this description appears to correspond with that given by Stimpson, which was taken at the Island of Amakirrima near Loo Choo.

Ours was trawled in shallow water in the narrows of the Philippine Islands associated with a male specimen of *Alpheus biunguiculatus*, which Stimpson says it resembles.

Alpheus gracilipes, Stimpson (Pl. CI. fig. 3).

Alpheus gracilipes, Stimpson, Proc. Acad. Nat. Sci. Philad., p. 100, January 1860.
„ „ Heller, Reise der Novara, Crust., p. 108.

Carapace one-third the length of the animal. Rostrum long and sharp; orbital lobes (fig. 3c) armed with short teeth, broad at the base.

First pair of antennæ having the three joints of the peduncle subequal, stylocerite reaching as far as the extremity of the first joint of the peduncle; outer flagellum stout at the base, and becoming suddenly slender, inner flagellum slender.

Second pair of antennæ having the peduncle a little shorter than that of the first; scaphocerite subequal in length with the peduncle; flagellum wanting.

First pair of pereiopoda (fig. 3*k*) having the chelæ unequal, the larger being on the left side. It is as long as the carapace, three times as long as broad, smooth on the lower side, and notched near the dactyloid articulation on the upper; dactylos about one-fourth the length of the propodos. Smaller chela wanting. Third and fourth pairs with the meros unarmed at the infero-distal angle; propodos (fig. 3*m*) furnished with long solitary spines, subequally distant, with a dactylos that is long, sharp, and uniunguiculate.

The telson (fig. 3z) is narrow, tapering, armed with a spine at each posterior angle, and a few long hairs between them; dorsal surface smooth.

Length, entire,	15	mm. (0·6 in.).
„ of carapace,	5	„
„ of pleon,	10	„
„ of large chela,	5	„
„ of dactylos of large chela,	1·5	„

Habitat.—Station 162, April 2, 1874; lat. 39° 10′ 30″ S.; long. 146° 37′ 0″ E.; off East Monccœur Island, Bass Strait; depth, 38 fathoms; bottom, sand and shells. Two specimens. Dredged.

Dr. Stimpson obtained his specimens from a coral reef near the Island of Tahiti, at the depth of 1 fathom; and Heller records it from the same locality.

Observations.—Our specimens appear to differ from Stimpson's description, in having the joints of the peduncle of the first pair of antennæ subequal instead of the second being twice as long as the first, as that author has described it. Although the one in the Challenger collection was taken south of Australia, and Dr. Stimpson's at Tahiti, I do not think that the slight differences warrant a specific separation.

Alpheus biunguiculatus, Stimpson (Pl. CI. fig. 4).

Alpheus biunguiculatus, Stimpson, Proc. Acad. Nat. Sci. Philad., p. 100, 1860.
„ *charon*, Heller, Sitzungsb. math.-nat. Cl. k. Akad. Wiss. Wien, Bd. xliv. p. 272, Taf. iii. figs. 21, 22.
„ „ Heller, Reise der Novara, Crust., p. 107.

Rostrum and supraorbital teeth subequal in length.

First pair of antennæ a little longer than the carapace.

The second pair a little shorter than the entire animal; the peduncles of each pair being subequal, that of the second reaching a little beyond that of the first. The stylocerite is longer than the first joint of the peduncle, and the scaphocerite is sharp pointed and as long as the peduncle.

The larger chela is lost in the two Challenger specimens, the smaller is of narrow form, and has the dactylos and pollex subequal, and about half the length of the palm. The second pair of pereiopoda has the carpos six-articulate, the first articulus being nearly as long as all the rest. Third and fourth pairs having the meros unarmed, the propodos furnished with small spines, and the dactylos biunguiculate.

Telson broad, slightly tapering to the extremity, which is convex, fringed with hairs and armed with two small spines at the angles, and two others on the lateral dorsal surface.

Length, entire,	11 mm. (0·44 in.).
„ of carapace,	4 „
Depth of carapace,	2 „
Length of pleon,	7 „
„ of rostrum,	1 „
„ of telson,	2 „

Habitat.—Station 208, January 17, 1875; lat. 11° 37′ N., long. 123° 31′ E.; off Manila; depth, 18 fathoms; bottom, blue mud. Two specimens; females, one with ova. Trawled.

Observations.—This species, which comes from the same station as *Alpheus spiniger*, corresponds very closely with Stimpson's description of *Alpheus biunguiculatus*. According to that author it differs from *Alpheus neptunus* in having no spine on the palm at the base of the fingers in the larger hand ("manus majoris palma spina ad basin digitorum armata"). In the two specimens in this collection the larger hand is wanting. Dana does not figure any such spine, neither does he allude to it in his description, and he also figures his species *Alpheus neptunus* as having the dactylos of the third and following pairs uniunguiculate, whereas Stimpson says that it is biunguiculate. Had Dana figured the fifth or last pair as being so formed, we might have supposed that he overlooked that of the third and fourth pairs; for frequently, if not always, when the dactylos of the third and fourth pair is biarticulate, that on the fifth is single; but as he figures the third pair we cannot suppose him to have been incorrect. I therefore attribute our specimens to Stimpson's species *Alpheus biunguiculatus*.

This species corresponds with Heller's description of *Alpheus charon*, which was procured off the Nicobar Islands, and of which he says that "this species possesses on the frontal margin three pointed, spine-like processes, the central one of which is somewhat the longest, and reaches as far as the anterior end of the first joint of the first antennæ. On the last three pairs of pereiopoda the chela is very short and furnished with a double claw. In most other points this species corresponds closely with *Alpheus neptunus*." I have thus been induced to associate them as the same species.

Alpheus neptunus, Dana (Pl. CI. fig. 2).

Alpheus neptunus, Dana, U.S. Explor. Exped., Crust., vol. i. p. 553, pl. xxxv. fig. 5.
„ „ Stimpson, Proc. Acad. Nat. Sci. Philad., p. 100, January 1860.

Anterior margin of the carapace anteriorly produced to a short sharp-pointed rostrum. Orbital margins anteriorly produced into a long tooth over each ophthalmopod, and subequal with the rostrum.

Pleon short, robust.

First pair of antennæ having the flagella unequal; first joint of the peduncle subequal with the two succeeding ones; stylocerite prolonged.

Second pair of antennæ having the scaphocerite short, not extending to the extremity of the terminal joint of the peduncle.

First pair of pereiopoda unequal, larger hand ovate, smooth; chela short; dactylos rounded, arcuate, scarcely one-third the length of the palm. The smaller hand robust and more normal in its form. Second pair of pereiopoda slender and multiarticulate, subequal in length with the first pair.

Length, entire,	17 mm. (0·6 in.).
„ of carapace,	8 „
Depth of carapace,	3·5 „
Length of pleon,	9 „
„ of telson,	2 „

Habitat.—Arafura Sea. One specimen; female.

Dana records his specimen from the Sooloo Sea at a depth of 6 fathoms, and from the Fiji Islands.

Betæus, Dana.

Betæus, Dana, U.S. Explor. Exped., Crust., vol. i. p. 558.

"Like *Alpheus* in the eyes, antennæ and feet. Front without beak. Anterior hands more or less inverted, the movable finger being the lower and outer."

Such is Dana's description, but it appears to me to be one more convenient for classificatory purposes than natural in arrangement.

In the most marked cases the rostrum is a very unimportant feature in this group, and is frequently reduced to a slender point, so that its absence altogether is a character that appears to me to be of secondary importance. Nevertheless it appears to be a very constant law, that an important, but not conspicuous, internal variation may be correlated with a slight but constant external variation in form.

Dana says that the inverted position of the propodos is also a marked character of the genus, but this appears not to vary much from the condition in some species of *Alpheus*, as the abnormal form of the propodos in its relation to the dactylos is one of the striking features of many of the species.

The arrangement of the branchiæ is the same as in *Alpheus*, and so are most of the external parts, but in one specimen, in which the female was gravid with ova, I observed that they differed from those of *Alpheus* both in form, size, and arrangement. In *Alpheus* the ova are generally round, small, and massed together, as in most Macrura, by small connecting threads, while in *Betæus* they are larger and more oval.

Geographical Distribution.—In the Challenger collection there are species from the Fiji Islands and Cape York.

Dana records *Betæus truncatus* from Hermite Island, Tierra del Fuego, where it was dredged in 10 fathoms. *Betæus æquimanus* from the "shores of Black Rocks, among seaweed, Bay of Islands, New Zealand," and *Betæus scabro-digitus* from Valparaiso, Chili.

Stimpson obtained *Betæus australis* from Port Jackson, among sublittoral seaweed, and *Betæus trispinosus* at a depth of 6 fathoms in the same locality.

Betæus malleodigitus, n. sp. (Pl. CI. fig. 5).

Dorsal surface of the carapace (in female) depressed over the cervical fossa. Orbital lobes enlarged, anteriorly produced to an obtuse point. Branchial walls deep, lessening anteriorly and posteriorly from the second pair of pereiopoda. Centre of frontal margin depressed and excavate (fig. 5*c*), the median line being slightly elevated, the elevation widening posteriorly to the orbital lobes.

The first pair of antennæ is slender and the stylocerite reduced to a minimum. The first joint of the peduncle is as long as the two following joints together.

The second pair of antennæ carries a long and slender scaphocerite, which consists chiefly of a spine that reaches as far as the extremity of the first joint of the peduncle of the first pair of antennæ, and scarcely to more than half the length of the terminal joint of the peduncle of the second pair.

The second pair of gnathopoda has the terminal joint evenly fringed with stiff hairs on each margin.

The first pair of pereiopoda is unequal in size, that on the right being smaller and more normal; the propodos is long, ovate, and the dactylos and pollex correspond in length and are about half the length of the palm. The propodos on the left side is large (fig. 5*k*), thick and rounded towards the carpal extremity, and tapering towards the dactylos, the extremity of which passes the articulation; the dactylos is short, stunted, and projects in two opposite directions, being shaped like a mallet.

The second pair of pereiopoda (fig. 5*l*) is long and slender, the carpos being five-articulate, the three distal articuli being equal, and the two proximal longer and subequal; the propodos is long and slender and with the dactylos forms a minute chela that is about half the length of the carpos. The posterior three pairs of pereiopoda are wanting, but the joints that remain show the posterior pair to be more slender than the two preceding.

The lateral walls or coxal plates of the pleopoda are less deep than the carapace.

Length, entire (female),	17 mm (0·68 in.).
„ of carapace,	6 „
Depth of carapace,	4·5 „
Length of pleon,	11 „
„ of telson,	2·5 „
„ of large chela,	8 „
„ of small chela,	4 „
„ of dactylos,	1·5 „
„ of second pereiopod,	16 „

Habitat.—Levuka, Fiji Islands, reefs. One specimen; female.

Observations.—As shown in the plate this specimen has attached to the pleopoda (fig. 5*q*) a number of egg-like bodies (fig. 5 *par*), which I at first took to be the ova, but a close inspection showed that each was attached by a peduncle to the stalk of the pleopoda. The surface of the capsule has a roughened appearance, and when it was ruptured by compression a number of what appeared to be the eggs of some animal, unknown to me, were liberated. Within each small sac was an embryo, but not sufficiently advanced to enable me to determine its characters (fig. 5 *par*). It is probably a parasite, and in general aspect resembles a minute *Sacculina*, but I do not think it belongs to that group, inasmuch as the embryo exhibits no Crustacean peculiarities.

Alpheus malleator, Dana, and *Alpheus obesomanus*, Dana, have the larger hand of the first pair of pereiopoda with the same peculiar mallet-shaped dactylos as is present in this species.

Betæus microstylus, n. sp. (Pl. CI. fig. 6).

Orbital lobes considerably produced, leaving the median line of the frontal margin depressed and excavate.

First pair of antennæ having the stylocerite not longer than the first joint of the peduncle.

Second pair of antennæ having the scaphocerite deeply cleft between the outer tooth and the squamous portion, which is fringed with hairs on the inner side.

Telson quadrate, laterally and dorsally armed with two small spines, and terminally fringed with hairs.

Length, entire,	25 mm. (1 in.).
„ of carapace,	8 „
Depth of carapace,	5 „
Length of pleon,	17 „
„ of telson,	3 „

Habitat.—Albany Island, Cape York. One specimen.

Observations.—There is only one specimen of this species in the collection, and that, unfortunately, has all the pereiopoda wanting, except the fourth on the left side. The general aspect of the animal corresponds nearly with that of *Betæus æquimanus*, Dana, from New Zealand, to which species I should have assigned it, had not Dana's description stated that "the basal spine of the inner antennæ (stylocerite) was very long, and the second joint was shorter than the first," whereas in our species the second joint is longer than the first and the stylocerite is very short, scarcely reaching to the extremity of the first joint; and further, that the "Basal scale of the outer antennæ (scaphocerite) is a little shorter than base, outer spine very short;" whereas in *Betæus microstylus* "the outer spine" is long, reaching to the extremity of the peduncles of both pairs of antennæ, and is separated by a deep narrow cleft or notch from the squamous portion of the same part of the organ.

This species is named from the smallness of the stylocerite, which forms the distinguishing feature that separates it from *Betæus æquimanus*, but I am very much inclined to doubt whether the length of this process is a feature sufficiently permanent to warrant a specific distinction.

Paralpheus, n. gen.

Anterior margin of the carapace dorsally carinated and produced to a laterally compressed rostrum; lateral walls of the carapace deep. Orbital lobes strongly defined and anteriorly produced to a point. Antennal margin of the carapace smooth, and the fronto-lateral angle rounded.

Ophthalmopoda hidden beneath the frontal margin of the carapace.

First pair of antennæ having a small stylocerite, and terminating in two flagella, of which the shorter divides near the extremity into two branches.

Second pair of antennæ having a long style attached to the basal joint, and carrying a scaphocerite that is rigid and styliform on the outer side, and separated from the foliaceous portion for a considerable distance from the extremity.

Mandible having the molar process cylindrical; psalistoma separate, flat and serrate; synaphipod short, broad, and uniarticulate.

Second pair of gnathopoda five-jointed; the coxa supporting a small podobranchia and the basis a long ecphysis; the penultimate joint, which probably homologises with the carpos, is short, and the terminal is long and tapering.

First pair of pereiopoda having the ischium produced at the infero-distal angle and freely articulating with the meros at the upper angle; the meros increases distally in breadth, and is produced at the upper angle to a point, and articulates with the carpos at the lower, the space between the two angles being excavate to receive the posterior extremity of the carpos, which is short, stout, and triangular. The propodos is

very broad, very long, thick, ovate, and terminates in a short pollex and a curved short dactylos. The second pair of pereiopoda is slender and multiarticulate; the third and fourth pairs are more robust than the second, and the fifth pair more slender than the preceding.

The pleopoda are long and biramose, and the rhipidura is broad, and fringed with hairs and strong teeth.

This genus probably belongs to the same group as that which Milne-Edwards calls the second, or those species which carry a pointed rostrum, viz.:—

B. A large spine fixed upon the external border of the basal joint of the second antennæ and directed forwards.

In this group Milne-Edwards places *Alpheus spinifrons*, Milne-Edwards, *Alpheus heterocheles*, Say, *Alpheus minus*, Say, *Alpheus villosus* (Olivier), and *Alpheus diversimanus* (Olivier).

Paralpheus diversimanus (Olivier) (Pl. CII.).

Palemon diversimanus, Olivier, Encycl., t. vii. p. 663.
„ *villosus*, Olivier, *loc. cit.*, t. viii. p. 664.
Alpheus villosus, Milne-Edwards, Hist. Nat. Crust., t, ii. p 354.
„ *diversimanus*, Milne-Edwards, *loc. cit.*, p. 355.

Body of the animal generally granulated and papillose, sparsely covered with rigid hairs.

The carapace is produced anteriorly into a rostrum that reaches as far forwards as the extremity of the first joint of the first pair of antennæ, and in the median dorsal line a second point projects above the orbits. The frontal margin projects over the ophthalmopoda, and is elevated into a prominent tubercle which is anteriorly armed with a sharp pointed tooth directed forwards. The branchial region is deeply produced on each side.

The first pair of antennæ has the first joint armed with a stylocerite that reaches nearly to the extremity of the joint; the second joint is cylindrical and a little longer than the first; the third joint is short and supports two slender flagella, of which the upper is the more robust for the greater part of its length, and then it suddenly becomes more slender.

The second pair of antennæ has the penultimate joint of the peduncle armed with a long and slender tooth that reaches nearly to the extremity of the scaphocerite, which also terminates in a sharp point and carries on the inner side a narrow plate that is separated for some distance from the rigid outer styliform extremity. The ultimate joint is cylindrical and reaches a little beyond the extremity of the scaphocerite, and carries a slender tapering flagellum that is as long as the animal.

The mandible has the psalistoma distinct from the molar process, broad, convex, and evenly serrate, and the synaphipod is broad, flat, spatuliform, and fringed with hairs.

The second pair of gnathopoda is robust, flattened on one side, and five-jointed, thickly fringed with hairs, and carrying a slender basecphysis.

The first pair of pereiopoda is unequal on the two sides, sometimes the left and sometimes the right being the larger. The smaller is normal in form, having the pollex and dactylos subequal and about as long as the palm; the carpos is short and triangular, and not so wide as the propodos; the ischium is long and anteriorly excavate to receive the carpos. The propodos on the larger limb is a characteristic feature, being about half the size of the animal; it is convex on the inner and flat on the outer side, ovate generally, broader towards the carpal joint and tapering towards the dactyloid. The pollex is short and tuberculated, the dactylos obliquely articulated, arched and obtuse at the point. The second pair is slender, long, and has the carpos five-articulate, and the chela minute and ovate. The third and fourth pairs are robust, with the posterior margin serrate and terminating in a short stout dactylos. The fifth or posterior pair is shorter and more slender than the preceding, and free from a serrate margin.

The rhipidura is broad and fan-shaped; the outer plate having two spines between two teeth on the outer margin.

The telson is shorter than the lateral plates, quadrate in form, the two posterior angles terminating in a short point or tooth and one spine, and fringed with long hairs.

	Male.	Female.
Length, entire,	25·5 mm. (1 in.)	38 mm. (1·5 in.).
„ of carapace,	8 „	14 „
„ of rostrum,	2 „	2·5 „
Depth of carapace,	7·5 „	11 „
Length of pleon,	17·5 „	24 „
„ of telson,	4 „	6·7 „
„ of large chela,	14 „	23 „
„ of dactylos of large chela,	3 „	5 „
„ of small chela,	12 „	18 „
„ of dactylos of small chela,	5 „	9 „
„ of second pereiopod,	21 „	28 „

Habitat.—Station 186, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; between Cape York and the Arrou Islands; depth, 8 fathoms; bottom, coral mud. Five specimens; one male and four females (length 39 mm.). Dredged.

Near Albany Islands, off Cape York. Two specimens; one male (28 mm. long), and one female (38 mm. long) bearing about twenty-five large, round ova.

The dorsal surface of the carapace carries a median subcarinated ridge, that projects forwards in the form of a compressed rostrum and is armed on the dorsal surface between the eyes with one strong tooth, and continues posteriorly until it fades away a little anterior to the posterior margin. The lateral walls of the carapace are deep

and project posteriorly beneath the coxal plate of the first somite of the pleon. The ophthalmopoda are short, movable, and lodged in a hollow tubercle that is elevated so as to appear almost as if it were the organ it covered, and is armed with a sharp pointed tooth projecting forwards.

The first pair of antennæ (*b*) has the first joint armed with a sharply pointed stylocerite that is nearly as long as the joint, and on the outer side with short stiff spines. The second joint is narrower than the first, a little longer, and cylindrical, while the third is less than half the length of the second and terminates in two slender flagella. The outer and upper flagellum, which is the stouter, remains thick for a considerable distance, and then lessens abruptly, and divides into two, one division being short and truncate and the other continuously slender.

The second pair of antennæ (*c*) carries on the second joint a long, slender, and sharp tooth that in length nearly equals the scaphocerite, which is also armed with a long and straight spine that reaches to the extremity of the terminal joint of the peduncle, and is separated for nearly half its length from the inner squamiform plate to which it is attached.

The mandibles (*d*) have an evenly serrate, convex, tenuous psalistoma, and a long, cylindrical, robust, molar tubercle, at the base of which a short, broad, thin, two-jointed synaphipod is attached.

The first pair of siagnopoda (*e*) is three-branched; the central branch is broad and spinous at the outer extremity, and smooth on the inner and outer margins; the inner plate is long, curved, and rigid, and the outer short, obtuse, and membranous; the two latter are almost free from hairs or cilia.

The second pair of siagnopoda (*f*) consists of a short central branch, an inner branch consisting of two plates, and an outer branch, which is produced anteriorly and posteriorly in the form of a scale, the margin of which is fringed with radiating cilia.

The third pair of siagnopoda (*g*) approximates to the preceding pair, but differs chiefly in having the mastigobranchial plate separated distinctly from the basecphysis.

The first pair of gnathopoda (*h*) is short and of great tenuity. It is seven-jointed, subpediform, and has the terminal joints squamiform, the dactylos, being broad and short, forms a ciliated marginal plate along the anterior portion of the propodos. The basis carries a long and slender ecphysis, and the coxa is furnished with a short triangular mastigobranchial plate without a branchia.

The second pair of gnathopoda (*i*) is pediform, long, robust, and five-jointed. The coxa carries a small podobranchial plume; the basis a short and slender ecphysis; the third joint, which probably represents the ischium and meros combined, is long, curved, and transversely triangulate; the following joint, which I presume represents the carpos, is short and triangular, and the terminal joint, which represents the propodos

and dactylos united, is long, tapering, tipped with long hairs, and fringed, particularly on the lower side, with numerous short ones, as also is the carpos and meros.

The first pair of pereiopoda (*k*) is unequal on the two sides, and has sometimes one sometimes the other hand the larger. In the typical specimen, that upon the right side is the smaller and more normal in form; it is moderately large and well developed; the propodos is long, and has the pollex as long as the dactylos and a little more slender, and both are inwardly curved at the apex, and have the inner margin fringed with hairs. The carpos is short, narrow and triangular; the meros is cupped at the carpal extremity, and articulates with the carpos at the inferior angle only, the upper angle being produced to a point and tipped with a bunch of hairs; the meros is long and the ischium short, as are also the basal joints. The coxa carries a short rudimentary mastigobranchial process. The hand upon the left side differs from that on the right in having the meros larger, and the antero-superior process more distinctly developed and hollowed to receive the posterior lobe of the carpos; the carpos is short and triangular; the propodos is unusually large, ovate, broader at the carpal extremity than at the dactyloid infero-anterior angle, which is produced in an obtuse pollex; the dactylos is broad, arcuate, and diagonally articulated with the propodos on the outer side. The second pair of pereiopoda is long and slender, with the hand minute and oval, the carpos five-articulate, the meros slender and the ischium robust. The third and fourth pairs of pereiopoda are stout and well developed, with the posterior margin serrate; the ischium is short, the meros and carpos long, the dactylos short and single-pointed. The fifth or posterior pair of pereiopoda resembles the preceding, but is generally more slender, and has the ischium proportionately longer, and the posterior margin smooth.

The pleopoda are long and flexible. The first pair (*p*) in both sexes carries one normally developed, and one rudimentary branch. The second (*q*) and following pairs are furnished with a long stylamblys, and the terminal pair, which forms the outer plates of the rhipidura (*vzv*), is armed at the outer distal angle with two strong divergent teeth, and between them two long movable spines, the plate having a well-marked diæresis. The distal margin of the outer as well as of the inner plate is fringed with a series of small teeth and fine hairs, of which those on the outer margin of the inner plate are the larger.

The telson is shorter than the lateral plates, and elongo-quadrate in general form; the posterior margin is slightly convex, fringed with long hairs, and armed at each angle with a sharp tooth and a small spine. The lateral margins are smooth but on each side of the median line is a strong ridge armed with two short spines, one distantly behind the other.

Our specimens appear to correspond more nearly with *Alpheus diversimanus* than with *Alpheus villosus*, as they are described by Milne-Edwards, and as they are

undoubtedly the same species, it is better to retain the specific name proposed by the author of the older though less recognised synonym.

Several specimens of this species were taken at the two localities given above. In the case of those from Albany Island the depth is not recorded, but I presume they were also taken in shallow water, and we may conclude that the species generally are the inhabitants of shallow seas, or swim near the surface of deeper waters. The ova are large and not numerous.

The branchial arrangement corresponds with that of *Alpheus* excepting by the absence of the mastigobranchial appendage to the second pair of gnathopoda and all the pereiopoda, in which it closely corresponds with *Synalpheus*, as may be seen by the following table :—

	h	i	k	l	m	n	o
Pleurobranchiæ,	...	...	1	1	1	1	1
Arthrobranchiæ,	...	...	...	...	...	...	...
Podobranchiæ,	...	1	...	...	...	...	...
Mastigobranchiæ,	1	...	...	...	...	...	...

Synalpheus, n. gen.

Carapace arcuate, dorsally elevated in the median line into a carina, and anteriorly produced to a slender rostrum that is subequal with the length of the peduncle of the first pair of antennæ. Orbital margin projected over the ophthalmopoda and produced to an anteriorly directed, prominent, sharp tooth; fronto-lateral angle produced to a point.

Ophthalmopoda concealed beneath the frontal margin of the carapace.

First pair of antennæ furnished with a strong sharply pointed stylocerite; upper flagellum the shorter and divided into two branches, of which one is truncated.

The second pair of antennæ furnished with a strong tooth on the outer side of the first and second joints of the peduncle; scaphocerite sharply pointed, the styliform process separated from the foliaceous plate for nearly half its length; flagellum long and slender.

The mandibles possess a stout molar process, a curved, sharply pointed, and almost rudimentary psalistoma, and a small two-jointed synaphipod.

The first pair of gnathopoda has the terminal joints enlarged and reflexed, the basis furnished with a strong multiarticulate ecphysis, and the coxa bearing a short and broad mastigobranchia.

The second pair of gnathopoda is five-jointed and pediform, the basis carries a long uniarticulate ecphysis, and the coxa has a small podobranchial plume.

The first pair of pereiopoda is slightly asymmetrical, having the carpos short, with the upper and lower distal angles projecting, and the chelæ large. The second pair is long and slender, having the carpos multiarticulate, and the chela minute. The posterior three pairs of pereiopoda terminate in a single pointed dactylos.

The somites of the pleon are deep and not strongly compressed; the three posterior somites rapidly narrow to the extremity of the telson, which is ovate, the lateral plates having a short diæresis, the outer angle of which is furnished with two strong spines.

The branchial apparatus corresponds with that of *Paralpheus* very nearly, and differs from that of *Alpheus* only in the absence of the rudiments of the mastigobranchiæ attached to the second pair of gnathopoda and all the pereiopoda in that genus, as shown in the following table :—

Pleurobranchiæ,	...	...	1	1	1	1	1		
Arthrobranchiæ,	...	...	...	...	...	...	...		
Podobranchiæ,	...	1	...	...	...	...	...		
Mastigobranchiæ,	1	...	...	...	...	...	...		
	h	i	k	l	m	n	o		

The aspect of the animal as a whole at once gives the idea of its distinctness from *Alpheus* and also from *Paralpheus*. The carina in the median line on the dorsal surface, the length of the smooth rostrum, and the production of the fronto-lateral angle of the carapace to a point, are suggestive of a separation from *Alpheus*, and the form of the mandibles and the absence of the mastigobranchiæ support this conclusion. But the separation from *Paralpheus*, although equally important is less conspicuous. The rostrum in both is remarkable for its length, but in *Paralpheus* it has a feeble tendency to denticulation on the upper surface. The stylocerite in *Paralpheus* is small, in *Synalpheus* it is large. There is only one tooth, and that remarkable for its length, attached to the base of the second pair of antennæ in *Paralpheus*, whereas there are two in *Synalpheus*.

The mandible in *Paralpheus* has a strong cylindrical molar process, a broad, flat, serrate psalistoma, and a short, spatuliform, uniarticulate synaphipod, while in *Synalpheus* the molar process is stout and cylindrical, the psalistoma is almost rudimentary, being little more than a large curved and pointed tooth, and the synaphipod is short and biarticulate. The first pair of gnathopoda carries a circular mastigobranchial plate in *Synalpheus* and a semicircular one in *Paralpheus*. The second pair of gnathopoda in *Paralpheus* is more robust, terminates in a point, and carries a slender uniarticulate basecphysis, while in *Synalpheus* this pair of appendages is less robust and has the distal two joints shorter than the preceding, terminates in a bifid apex, and carries a long, stout, uniarticulate basecphysis.

The first pair of pereiopoda is more asymmetrical in *Paralpheus* than in *Synalpheus*. The second pair corresponds in all respects, except in the numerical value of the articuli of the carpos. The third and fourth pairs are larger than the fifth in *Paralpheus*, whereas in *Synalpheus* they are correspondingly equal in form and power.

The rhipidura bears some general resemblance in the two genera, but differs in detail. In *Paralpheus* there is one large tooth at the outer angle of the basal joint of

the sixth pair of pleopoda, whereas in *Synalpheus* there are two, and the telson is quadrate in the former and ovate in the latter, being fringed with strong spines or teeth in *Paralpheus* as well as by numerous long hairs, whereas there are only marginal hairs in *Synalpheus*.

A strict comparison of the several features that distinguish *Paralpheus* from *Synalpheus* induces me to believe that the distinction in the form of the mandibles is the only one of true generic value, all the others only being points of greater or less specific difference, which gradually lead us to the family of the Hippolytidæ, as illustrated in the genus *Spirontocaris*.

Geographical Distribution.—This genus is limited to the only species known, and that has only been taken in the narrow and shallow strait between New Guinea and Australia.

Synalpheus falcatus, n. sp. (Pl. CIII.).

Carapace broad, deep, longitudinally arcuate, and about two-fifths the length of the animal; dorsally elevated into a carina that commences over the gastric region and is produced anteriorly to a rostrum that reaches as far as the distal extremity of the second joint of the peduncle of the first pair of antennæ. The orbital lobes are produced as sharp teeth that reach to half the length of the rostrum; a deep groove separates them from the median carina.

The first pair of antennæ has the three joints of the peduncle subequal, the first being rather the longest, and carries a stylocerite that reaches anteriorly as far forwards as the extremity of the rostrum; it terminates in two unequal flagella, the outer being about as long as the peduncle, and bifid at the extremity, and the inner being half the length of the animal.

The second pair of antennæ has the basal tooth as long as the tooth of the orbital lobe; the scaphocerite is pointed, longer than the rostrum, and shorter than the peduncle; the antennæ terminate in a flagellum that is as long as the animal.

The second pair of gnathopoda reaches about as far forwards as the extremity of the rostrum.

The first pair of pereiopoda has the larger chela on the left side; in our specimens of the female it is wanting, but in the male it is more than half the length of the animal and narrow, being about three times longer than broad. The meros is armed with a tooth at the upper distal angle; the carpos is short and armed with a tooth at the lower and upper angles; the dactylos is broad, curved, and furnished with a large tuberculose tooth near the joint on the under side, which, when closed, shuts into a hollow. The smaller chela is very short, the meros is armed with a strong tooth at the upper distal angle; the carpos having a similar one at the upper and lower angles;

the propodos is not longer than the dactylos of the larger chela; the dactylos is much longer than the pollex and curved in the form of a hook. The second pair of pereiopoda is long and slender, and the carpos seven-jointed, the first articulus being as long as the three following; it terminates in a small chela.

Telson broad at the base and tapering, rounded at the distal margin, fringed with hairs and dorsally armed with two spines on each side of the median line.

Length, entire (female),	33	mm. (1·3 in.).
„ of carapace,	13	„
Depth of „	10	„
Length of pleon,	20	„

The males are smaller and less robust.

Length, entire (male),	23	mm. (0·9 in.).
„ of carapace,	9	„
Depth of „	6	„
Length of pleon,	14	„
„ of large chela,	16	„
Width of „ „	4	„
Length of dactylos of large chela,	5	„
„ of small chela,	5	„
„ of dactylos of small chela,	3	„
„ of pollex of „	1·5	„

Habitat.—Station 186, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; between Cape York and the Arrou Islands; depth, 8 fathoms; bottom, coral mud. Six specimens; four males and two females. Dredged.

This species may be readily known by the elevated dorsal median ridge, which rises from the apex of the rostrum and continues as a small carina to the posterior extremity of the gastric region, where it is lost. The female is more than one-fourth longer and broader than the male and carries many broadly ovate ova, 1·5 mm. in the longest diameter.

The ophthalmopoda are observable as semi-movable organs beneath the carapace and a longitudinal ridge corresponds with the outer angle of the first pair of antennæ. The stylocerite is nearly as long as the rostrum and longer than the first joint of the peduncle (c, *b*). The phymacerite attached to the second pair of antennæ terminates in a strong, tooth-like, but not very prominent point. The mandible (*d*) has a large molar protuberance, a small tooth-like process representing the psalistoma, and a small two-jointed synaphipod, and bears a closer resemblance to the same organ in *Spirontocaris* than to that in *Alpheus*. The other oral appendages agree with those of *Alpheus*, or when they differ the differences are only such as may be expected in characters of

specific importance. The chelæ are unequal, and although the larger has a resemblance to that of *Alpheus*, yet it approaches to the more normal character of that appendage in other genera, rather than to the oblique and distorted form that is frequently found in *Alpheus*.

Family Hippolytidæ.

The genera in this family comprise those in which the carapace is produced to an important rostrum, in which the first pair of pereiopoda is chelate and moderately robust; the second pair slender with the carpos multiarticulate, and the posterior three pairs of pereiopoda simple.

It contains several genera, of which those represented in the Challenger collection are briefly defined below :—

Platybema, n. gen.

Rostrum laterally compressed, deep.
Mandible without synaphipod or psalistoma.
First pereiopod chelate; carpos excavate.
Second pereiopod chelate; carpos biarticulate.

Latreutes, Stimpson.

Rostrum laterally compressed, deep, serrate.
Mandible without synaphipod or psalistoma.
First pereiopod chelate; carpos excavate.
Second pereiopod chelate; carpos triarticulate.

Hippolyte, Leach.

Carapace with a supraorbital and an antennal tooth. Rostrum slender, toothed.
Mandible without synaphipod, and with psalistoma.
First pereiopod chelate; carpos distally excavate.
Second pereiopod chelate; carpos triarticulate.
Branchiæ five in number; mastigobranchiæ four, rudimentary.

Spirontocaris, n. gen.

Carapace carinated, with two supraorbital and an antennal tooth. Rostrum deep, serrate.
Mandible with a rudimentary biarticulate synaphipod, and with a rudimentary psalistoma.

First pereiopod chelate; carpos not, or but slightly, excavate.
Second pereiopod chelate; carpos seven-articulate.
Branchiæ six in number; mastigobranchiæ five, rudimentary.

Nauticaris, n. gen.

Carapace without supraorbital, but with an antennal tooth. Rostrum compressed, slender, serrate.
Mandible with triarticulate synaphipod; without psalistoma.
First pereiopod chelate; carpos not excavate.
Second pereiopod chelate; carpos seven-articulate.
Branchiæ thirteen in number; mastigobranchiæ six, rudimentary.

Hetairus, n. gen.

Carapace with one supraorbital and one antennal tooth. Rostrum long, narrow, and dentate.
Mandible with two-jointed synaphipod; without a psalistoma.
First pereiopod chelate; carpos not excavate.
Second pereiopod chelate; carpos seven-articulate.
Branchiæ six in number; mastigobranchiæ four, rudimentary.

Merhippolyte, n. gen.

Carapace without any supraorbital teeth. Rostrum long, slender, serrate.
Mandible with triarticulate synaphipod, and with psalistoma.
First pereipod chelate; carpos not excavate.
Second pereiopod chelate; carpos multiarticulate.
Branchiæ twelve in number; mastigobranchiæ six, rudimentary.

Chorismus, n. gen.

Carapace without any supraorbital tooth. Rostrum long, deep at base, laterally compressed.
Mandible with triarticulate synaphipod, and rudimentary psalistoma.
First pereiopod chelate; carpos not excavate.
Second pereiopod chelate; carpos multiarticulate.
Branchiæ seven in number; mastigobranchiæ four.

Amphiplectus, n. gen.

Carapace without supraorbital tooth, but with orbital and antennal teeth. Rostrum slender, minutely serrate.

Mandible with biarticulate synaphipod and psalistoma, but without molar process.

First pereiopod chelate, slender; carpos not excavate.

Second pereiopod chelate; carpos multiarticulate.

Branchiæ ten; mastigobranchia, one.

Platybema,[1] n. gen.

Clyclorhynchus, de Haan, in v. Siebold's Fauna Japonica, p. 174 (*nom. præoc.*).
Rhynchocyclus, Stimpson, Proc. Acad. Nat. Sci. Philad., 1860, p. 96 (*nom. præoc.*).

Rostrum orbiculatum, compressum, membranaceum, oculis et antennis intervenit. Antennæ internæ bisetaceæ, setis brevibus. Max. 5^{arum} art. secundus articulis duobus ultimis conjunctis æqualis; art. ultimis spinulosus, penultimo bis longior; palpi oblongi. Max. 4^{arum} art. tertius longior secundo; penultimus abbreviatus. Mandibulæ incurvatæ, corona simplice cylindrica, palpis nullis. Pedes secundi didactyli, tenuiores primis, carpis brevibus annulatis. Sternum trigonum." (De Haan, *loc. cit.* *Rhynchocyclus* (*Lysmata*) *planirostris*,[2] de Haan, type.

Carapace dorsally carinated, produced anteriorly to a large, laterally compressed, deep rostrum, which projects below the level of the dorsal ridge and is inserted between the antennæ. Pleon generally, but slightly, compressed laterally, having the lateral coxal plates largely developed.

Ophthalmopoda short.

First pair of antennæ short, the peduncle not reaching to the extremity of the scaphocerite; flagella two, short, extending but little beyond the extremity of the rostrum.

Second pair of antennæ having a short and broad scaphocerite that narrows towards the extremity, is armed with a small tooth on the outer margin and fringed with long hairs on the inner, and does not reach beyond the extremity of the rostrum; flagellum about half the length of the animal.

Mandibles short, strong, cylindrical, without a psalisiform process or synaphipod.

First pair of gnathopoda six-jointed. Whether the coxa carries any rudiment of a branchial plume or not I have not determined. The basis carries a long and robust two-jointed ecphysis; the other joints are short, the carpos is sinuous and partially encroaches on the propodos, which articulates against the anterior margin in its entire length, and has the margin armed with long, curved, ciliated spines.

[1] πλατύς, flat, βῆμα, rostrum.

[2] *Hippolyte planirostris*, de Haan, in v. Siebold's Fauna Japonica, Crust., tab. xlv. fig. 7.
Lysmata planirostris, *loc. cit.*, tab. O.
Cyclorhynchus planirostris, *loc. cit.*, p. 175.

The second pair of gnathopoda is five-jointed. Whether the coxa carries a small podobranchial plume or not I have not determined. The basis supports a two-jointed ecphysis; the ischium is long, straight, robust, and is probably combined with the meros; the carpos or penultimate joint is short and the terminal one long.

The first and second pairs of pereiopoda are short; the first is robust and chelate, having the carpos short, and anteriorly excavate to receive the extremity of the propodos, which articulates with it at the infero-distal angle. Second pair of pereiopoda slender and minutely chelate; carpos biarticulate.

Pleopoda biramose, foliaceous, unequal.

Telson triangular.

I have not seen the typical species of this genus, but comparing the specimen in the collection, which I have named *Platybema rugosus*, with de Haan's description and figure of *Platybema* (*Hippolyte*) *planirostris*, I consider that the two belong to the same genus. Stimpson in his diagnostic description of the genus, from a specimen of *Platybema planirostris* that he took in the Gulf of Hakodadi, near the northern shores of Niphon Island, says that the anterior four pairs of pereiopoda are furnished with an ecphysis (epipod), and that the carpos of the second pair of pereiopoda is triarticulate. De Haan in his description says that it is annulated, but he does not so figure it in his plate, but makes the carpos long, straight, and uniarticulate. This appears to be also the condition of the part in *Platybema rugosus* when examined under a low magnifying power, but under a higher one it is resolved into a biarticulate condition.

Platybema rugosus, n. sp. (Pl. CIV. fig. 2).

Robust and dorsally arcuate. Carapace dorsally carinated and anteriorly produced to a deep rostrum that suddenly slopes from the crest, which is armed with teeth from the posterior margin of the carapace to the distal extremity of the rostrum. Pleon having the anterior two somites elevated in front, the third and succeeding somites smooth, excepting the sixth, which is armed with small teeth near the posterior margin. Telson having the lateral and distal margins serrate.

Length, entire,	19	mm. (0·7 in.)
„ of carapace,	7	„
„ of rostrum,	2·5	„
Depth of rostrum,	2	„
„ of carapace,	5	„
Length of pleon,	12	„
„ of telson,	2·8	„
„ of first pereiopod,	4·5	„
„ of second pereiopod,	7	„

Habitat.—Station 24, March 25, 1873; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; off Culebra Island, West Indies; depth, 390 fathoms; bottom, Pteropod ooze. One specimen; female. Dredged.

The carapace is nearly half the length of the animal; it is dorsally carinated and anteriorly produced to a laterally compressed and deep rostrum, that projects below the level of the dorsal ridge, and is inserted deeply between the antennæ. It is serrate on the dorsal surface, two rather large teeth being placed posterior to the cervical fissure, and the others anterior to it; the latter gradually decrease in size and traverse the margin of the rostrum to the under surface of the distal extremity. The inner and the outer canthus of the orbit is furnished with a small tooth. The fronto-lateral angle of the carapace is produced to a prominent point, and the lateral walls are adorned with tubercles.

The anterior two somites of the pleon are dorsally smooth, but their anterior margins are elevated, so that when viewed laterally the elevations resemble teeth. The third, fourth, and fifth somites are smooth and even, and the sixth is dorsally armed with two rows of teeth.

The telson (fig. 2*z*) is triangular and furnished with small spines on each lateral margin and on the terminal extremity.

The ophthalmopoda are short and orbicular.

The first pair of antennæ scarcely reaches beyond the apical extremity of the rostrum; the first joint of the peduncle is longer than the ophthalmopod, the second and third are short and subequal. The second pair of antennæ is about as long as the carapace, and carries a scaphocerite that does not reach quite to the extremity of the rostrum.

The mandibles (fig. 2*d*) are short and robust, and have the molar process furnished with a series of small serrate teeth, and one strong conical tooth in the centre. The first pair of gnathopoda (fig. 2*h*) is six-jointed, the last two joints being reflexed against the preceding; the basis carries a long and slender ecphysis that is three times as long as the limb.

The first pair of pereiopoda (fig. 2*k*) is robust and short, having the chela strong, articulating with the carpos at the inferior angle; the pollex and dactylos are tipped with hairs, and a fasciculus of similar hairs tips the upper distal extremity of the carpos and meros also. The second pair of pereiopoda (fig. 2*l*) is slender and feeble; the two articuli of the carpos being each subequal in length to the palm of the propodos; the dactylos is short and stout, the pollex slender.

The third pair of pereiopoda is also feeble, corresponds in length with that of the second pair, and terminates in a short simple dactylos. The fourth and fifth pairs are broken off at the coxal joints.

The pleopoda are biramose, the second pair (fig. 2*q*) has the branches foliaceous, the outer tapering, the inner broad, discoidal, and fringed with plumose hairs, and on the inner margin is a single short stylamblys tipped with a few cincinnuli. On the inner side of the basal joint there are numerous long hairs to which the ova are attached.

Latreutes, Stimpson.

Latreutes, Stimpson, Proc. Acad. Nat. Sci. Philad., January 1860, p. 96.

Resembles *Platybema*. Rostrum elongate, being more than half the length of the carapace, laterally compressed and deep.

First pair of antennæ subequal in length to the rostrum.

Second pair carrying an acutely pointed scaphocerite.

Mandible without synaphipod or psalistoma, the molar process alone being present, and curved at nearly a right angle with the apophysis.

The first pair of gnathopoda is seven-jointed and carries a mastigobranchia and an ecphysis.

The second pair is five-jointed, robust and rigid, carries a small podobranchial plume and a short ecphysis, and terminates in an obtuse extremity.

The first pair of pereiopoda is short and robust and terminates in strong and simple chelæ; the propodos articulates with the carpos at the inferior angle, the upper portion falling into an excavation in the distal margin of the carpos; the carpos also articulates with the meros at the infero-distal extremity, and when extended falls into a similar excavation. The second pair of pereiopoda is slender and chelate, the carpos being triarticulate. The posterior three pairs of pereiopoda are slender and terminate in a simple dactylos.

The pleopoda are biramose, the branches being subequal. The telson tapers to a point.

This diagnosis differs in some points from that given by Stimpson. That author says that the carapace is armed with a dorsal median tooth; this is the case in his typical species, *Latreutes ensiferus*, while in *Latreutes unidentatus* and in *Latreutes dorsalis* there are two; but on the other hand *Latreutes planus* has none, and with this exception the resemblance of this species to *Latreutes unidentatus* is very close.

The chief distinction of this genus from *Platybema* appears to me to exist in the number of articulations in the carpos of the second pair of pereiopoda. In the typical species, *Latreutes ensiferus*, of which I have had a great number for examination, the carpos is triarticulate, and in *Platybemas* according to my experience of *Platybema rugosus*, the carpos is only biarticulate. The species of the two genera

resemble one another so closely in form that their distinction may be most easily determined by the length of the rostrum and the general robust character of those of *Platybema* when compared with those of *Latreutes*.

The branchial arrangement consists of six plumes, of which five are pleurobranchiæ and one podobranchia, attached to the coxa of the second pair of gnathopoda, as shown in the annexed table :—

	h	i	k	l	m	n	o
Pleurobranchiæ,	...	...	1	1	1	1	1
Arthrobranchiæ,	...	...	...	...	...	...	...
Podobranchiæ,	...	1	...	...	...	...	...
Mastigobranchiæ,	...	...	...	...	...	...	...

Geographical Distribution.—*Latreutes ensiferus* is abundant among the common floating Gulf-weed, *Sargassum bacciferum*, in the Atlantic Ocean, and therefore lives at the surface of the sea, whereas *Latreutes dorsalis* is common near Japan on a shelly bottom at the depth of 8 fathoms; *Latreutes unidentatus* and *Latreutes planus* were taken near the surface at the Philippine Islands, but were not apparently very abundant.

Observations.—This genus was established by Stimpson to receive a species which was first described by Milne-Edwards from a specimen taken in the North Atlantic Ocean near the Azores, and which he named *Hippolyte ensiferus*.[1] Dr. Stimpson considered it to belong to the same genus as his *Latreutes dorsalis*, which he found common on a shelly bottom at the depth of 8 fathoms in the Gulf of Hakodadi, Japan, and says that it is in close affinity with *Cyclorhynchus* (*Platybema*) of de Haan, which was taken in the same locality. Close comparison of the figures of the parts given by de Haan under the name of *Lysmata planirostris*[2] and of the figure under the name of *Hippolyte planirostris*,[3] supports the opinion of the close affinity of de Haan's genus *Cyclorhynchus* (*Platybema*) with that of *Latreutes*, Stimpson.

De Haan describes his genus as having the "Rostrum orbiculatum," but this cannot be accepted as of generic value, inasmuch as the length of the rostrum is liable to vary in the same genus, consequently its orbicular condition would become oval as it is in *Platybema mucronatus* (Stimpson). In a species brought from Australia, by Mr Angas, and preserved in the British Museum, which I described in 1863[4] under the name of *Caradina truncifrons*, there is little to define it from *Platybema planirostris* (de Haan), excepting that the rostrum, instead of being orbicular, has the upper distal extremity quadrate, and the carpos of the second pair of pereiopoda is triarticulate.

The two genera possess the peculiar feature in the first pair of pereiopoda of the

[1] Hist. Nat. Crust., tom ii. p. 374.
[2] In v. Siebold's Fauna Japonica, tab. O.
[3] *Loc. cit.*, tab. xlv. fig. 7.
[4] *Trans. Zool. Soc. Lond.*, p. 499, pl. xl. fig. 2, 1863.

propodos articulating with the carpos at the inferior angle only, giving the appendage the appearance of partial dislocation. This is a character that was first noticed by Milne-Edwards in the genus *Caridina*, and has been overlooked by Stimpson and de Haan in their descriptions of *Platybema*. The type of *Latreutes* is distinguishable from that of *Platybema* by the form of the rostrum, which is orbicular in one and cultriform in the other, but according to my observations the two genera approach each other even in this character, and the only anatomical features that appear to distinguish one from the other, exist in the first pair of gnathopoda and in the second pair of pereiopoda, and these can be better appreciated by comparing the figures than from a complicated description.

Latreutes ensiferus (Milne-Edwards) (Pl. CIV. fig. 1).

Hippolyte ensiferus, Milne-Edwards, Hist. Nat. Crust., t. ii. p. 374.
Latreutes ensiferus, Stimpson, Proc. Acad. Nat. Sci. Philad., January 1860, p. 96.

Body slender and but slightly sinuous at the third somite of the pleon. Carapace dorsally rounded, armed with a small tooth on the gastric region. Rostrum nearly as long as the carapace, vertically broad, of extreme tenuity, slightly curved upwards on the upper surface towards the apex; extremity serrate, lower margin smooth and curved downwards in the middle. Antero-lateral angle of the carapace serrate with five or six small teeth.

Ophthalmopoda of medium size.

Second pair of gnathopoda (fig. 1*i*) having the penultimate joint short and fringed with spines on the distal margin, the terminal joint long and fringed with spines on the inner margin, and the antepenultimate as long as the two preceding, which circumstance de Haan considers of sufficient importance to be regarded as of generic value. This joint is armed on the distal half of the outer margin with stiff movable spines, the basis carries a short ecphysis, and the coxa a podobranchial plume.

The first pair of pereiopoda (fig. 1*k*) is short and robust, the meros is excavate to receive the carpos, and the carpos is excavate to receive the posterior upper lobe of the propodos; the upper distal angle projects over the propodos and is tipped with a fasciculus of long hairs. The propodos articulates with the carpos at the lower angle and is broader at this extremity than at the dactyloid; the dactylos is broad and spoon-shaped, and corresponds in length with the pollex. The second pair of pereiopoda (fig. 1*l*) is longer than the first, slender, feeble, and minutely chelate; the carpos is triarticulate, the central articulus being the longest, and together the three are longer than the propodos, of which the fingers are nearly half the length. The other pereiopoda are moderately long and robust, the propodos is long and the dactylos short; the former is furnished with long spines on the under surface, and the dactylos

with a series of small spines on the same side, that increase in length as they approach the distal extremity, where the ultimate spine nearly equals the unguis in importance (fig. 1*m*).

The pleon is smooth and the telson is triangulate.

	Female.	Male.
Length, entire,	16 mm. (0·6 in.).	12 mm. (0·4 in.).
„ of rostrum,	3·5 „	2·5 „
„ of carapace,	4 „	3 „
Depth of carapace,	3 „	2 „
Length of pleon,	12 „	9 „
„ of telson,	3 „	2 „

Habitat.—Atlantic Ocean, on Gulf-weed.

In the open ocean near the Azores by M. Reynaud (Milne-Edwards).

In the Atlantic Ocean, lat. 30° to 35°; common on the Sargasso weed (Stimpson).

The typical specimens in the Challenger collection were taken near Bermuda, in April 1873, in large numbers, many hundreds, of both sexes, in apparently equal proportions, associated in equal abundance with *Palæmon natator*. On the 4th of May 1876, on the homeward passage of the ship, between Stations 355 and 354, south of the Azores, about a dozen others were taken, and some among these showed a variation which enabled me more readily to determine the sexes, since the males generally had the extremity of the rostrum less perfectly dentated, the first pair of antennæ with the outer branch thicker and longer, and the scaphocerite longer, and more pointed.

Palæmon fucorum, Fabricius,[1] undoubtedly belongs to this genus, and from the statement that the rostrum is armed at the extremity with five teeth, I should have believed it to be the original of this species had not the author stated that the carapace is smooth ("Thorax lævis"), whilst a small tooth stands above the gastric region in *Latreutes ensiferus*.

On one specimen I found a small species of *Bopyrus* which I name *Bopyrus latreutis*, since it differs from *Bopyrus squillarum*, Latr., in having a rounded caudal extremity, as well as in size.

Latreutes planus, n. sp. (Pl. LXXXIX. fig. 5).

Carapace dorsally unarmed and produced to a robust rostrum which is deep, laterally compressed, anteriorly pointed, and serrate. Dorsal surface of the carapace smooth and free from ornamentation. Pleon dorsally smooth, posterior extremity of the sixth somite produced to a small tooth.

[1] Suppl. Entom. Syst., p. 404.

First pair of antennæ more robust than the second.
First pair of pereiopoda shorter and more robust than the second.
Telson about half the length of the lateral plates of the rhipidura.

Length, entire,	6 mm. (0·2 in.).
„ of rostrum,	1·5 „
„ of carapace,	1·5 „
Depth of carapace,	1 „
Length of pleon,	4·5 „
„ of telson,	0·6 „

Habitat.—Off Sibago, Samboangan, Philippine Islands, October 23, 1874. One specimen.

The body of the animal is moderately robust, the carapace being the broadest part and dorsally elevated, anteriorly depressed and produced to a deep, laterally compressed rostrum, which projects to an acute point at the apex and is armed with a serrature of teeth, five of which are below the apex and ten above; the dorsal surface of the carapace is smooth, rising behind the gastric region, and continuous with the dorsal surface of the pleon. The telson is about half the length of the sixth somite.

The ophthalmopoda are short, stout, and carry a prominent tooth on the inner side of the globular ophthalmus.

The first pair of antennæ has the first joint of the peduncle subequal in length with the ophthalmopod and curved in correspondence with it, the upper distal angle being produced to a strong tooth or process; the second and third joints are short and subequal in length, and produced on the upper distal angle. The inner flagellum is short, stout, and tapering, reaching a little beyond the apex of the rostrum, it is multiarticulate, and fasciculi of membranous cilia arise from alternate articuli.

The second pair of antennæ is broken off at the extremity of the peduncle; the scaphocerite is narrow and reaches nearly to the distal extremity of the rostrum.

The oral appendages have not been examined in this species.

The second pair of gnathopoda is moderately long and robust; the lower or posterior surface is smooth and straight, the upper or anterior is arcuate and furnished with transverse rows of fasciculi of hairs, and tapers to an acute point.

The first pair of pereiopoda is short and robust. The second pair is long and slender, and terminates in a chela that has the dactylos longer than the pollex. The posterior three pairs of pereiopoda are slender and subequal, and terminate in a moderately long and slender dactylos, the propodos of each being fringed with fasciculi of hairs.

The first pair of pleopoda is simple, the others are biramose, the posterior pair being furnished with subequal rami that terminate in rounded extremities.

Observations.—This species was found associated with *Latreutes unidentatus.*

Latreutes unidentatus, n. sp. (Pl. LXXXIX. fig. 6).

Robust. Carapace armed with one large tooth on the gastric region, and anteriorly produced to a rostrum that is nearly as deep as the carapace, pointed in front, and having the margin serrate above with eight teeth, and below with five.

The pleon is smooth and the telson is as long as the sixth somite.

Length, entire,	5·5	mm. (0·2 in.).
„ of carapace,	1·5	„
„ of rostrum,	1	„
Depth of carapace,	1·5	„
Length of pleon,	4	„
„ of telson,	0·7	„

Habitat.—Off Sibago, Samboangan, Philippine Islands, October 23, 1873. Associated with the preceding species.

The animal is not so robust as *Latreutes planus* but more so than *Latreutes ensiferus*.

The dorsal surface of the carapace is flattened, and armed with a strong tooth over the gastric region, whence the frontal margin projects to a rostrum that is nearly as long and as deep as the carapace. The serrature on the upper surface reaches about halfway between the apex and base, and is formed by eight small teeth, and the lower margin by five; the apical tooth being sharp and prominent. The pleon is dorsally smooth, and has no tooth on the posterior margin of the sixth somite, which is shorter than in the preceding species, and has the telson subequal in length with it.

The ophthalmopoda are moderately robust, but longer than in the preceding species, and do not carry a projecting tooth upon the inner surface, but are perfectly smooth. The first pair of antennæ is robust, and does not reach beyond the apex of the rostrum; the first joint of the peduncle is subequal with the ophthalmopod, the second and third are shorter and subequal in length, and the inner flagellum, which is robust and tapering, reaches as far as the apex of the rostrum, and supports a series of fasciculi of membranous cilia. The second pair of antennæ is broken off at the extremity of the peduncle, and supports a slender pointed scaphocerite that is nearly as long as the rostrum.

The oral appendages of this species have not been separately examined.

The second pair of gnathopoda is robust and powerful, smooth on the lower surface, arcuate and firm, with rows of hairs on the upper, and terminates in an acute point.

The first pair of pereiopoda is short and robust, the second long and slender, the dactylos and pollex being subequal and fringed with fasciculi of hairs. The posterior three pairs correspond with those of *Latreutes planus*.

The pleopoda are of generic value, only the posterior pair having the rami subequal, and about one-third longer than the telson.

Observations.—Dr. Stimpson[1] describes a species under the name of *Latreutes dorsalis*, which is armed with two teeth on the dorsal surface of the carapace, of which the anterior is spiniform and directed anteriorly, and the other obtuse and nearly obsolete. His species was taken in the Gulf of Hakodadi, Japan, where it is common on shelly bottoms at a depth of 8 fathoms. He describes its colour as being a brilliant scarlet ("coccineus"), and having a white dorsal band.

Hippolyte, Leach.

Hippolyte, Leach, Trans. Linn. Soc. Lond., vol. ix. p. 346; Edin. Ency., vol. viii. p. 432, 1815; Ency. Brit., Supp. 1, p. 421; Mal. Pod. Brit., tab. xxxviii., 1815–17.
„ Milne-Edwards, Hist. Nat. Crust., t. ii. p. 370.
Verbius, Stimpson, Proc. Acad. Nat. Sci. Philad., p. 104, 1860.
„ Heller, Crust. süd. Europ., p. 284, 1863.
Hippolyte, Kinahan, Proc. Nat. Hist. Soc. Dublin, p. 47, figs. 1–6, 1867.
Verbius, Miers, Cat. Stalk-Eyed Crust. of New Zealand, p. 81, 1876.
„ Kingsley, Proc. Acad. Nat. Sci. Philad., p. 421, 1879.
„ Sars, Forhandl. Vidensk. Selsk., No. 18, p. 7, 1882.

Carapace anteriorly carinated and produced into a laterally compressed rostrum, the upper margin of which is parallel with the dorsal surface of the carapace and armed with teeth; the under margin is excavated at the base and serrate towards the extremity. The fronto-lateral surface is armed on each side with a supraorbital and an antennal tooth. Pleon smooth, third somite posteriorly produced in the median dorsal line, and somewhat arcuate. Telson dorsally flat, laterally compressed, posteriorly tapering, and furnished with two solitary spines on each side, longitudinally situated on the dorso-lateral surface.

The ophthalmopoda are short, uniarticulate and pyriform.

The first pair of antennæ has the first joint of the peduncle excavate, and armed with a sharp stylocerite that is subequal with it in length. The second and third joints are smaller and subcylindrical, the terminal supporting two short flagella, of which the outer is the shorter and more robust.

The second pair of antennæ carries a terminally ovate scaphocerite that is distally armed with a tooth on the outer margin, and a flagellum that is subequal with the length of the animal.

The second pair of gnathopoda carries a short basecphysis, and terminates in a joint that is distally truncate and furnished with small spinules.

The first pair of pereiopoda is short, stout and chelate; the carpos is triangulate

[1] *Proc. Acad. Nat. Sci. Philad.*, January 1860, p. 96.

and excavated to receive the extremity of the propodos. The second pair of pereiopoda is slender, a little longer than the first, chelate, and has the carpos triarticulate. The posterior three pairs of pereiopoda are short, slightly decrease in length posteriorly, and have the dactylos "spinulose within."

This diagnosis is drawn up after an examination of the type specimen of *Hippolyte varians* in the British Museum, and from Leach's description, to which he adds, "Montagu sent to me *Hippolyte varians*, the type of this genus," the definition of which he gives as "Hippolyte rostro acuminato ante medium subtus bi-serrato; pone medium et ad apicem supra uniserrato."

The following additions to the above definition are taken from recent specimens which have been found on the coasts of Devon and Cornwall.

The mandible has the molar process at less than a right angle with the apophysis; the psalistoma is reduced to a narrow process serrate on the inner margin, and the synaphipod is wanting.

The first pair of pereiopoda is stout and short, having the propodos articulating with the carpos at the lower angle, a concave excavation being formed by the advanced condition of the upper angle, in which hollow the extremity of the propodos lies when the appendage is extended; chela having the fingers subequal and hollow. The second pair of pereiopoda is slender, and has the carpos triarticulate.

Dr. Leach in his description of the genus says "carpo multi-articulato," but figures the joint as triarticulate. The variance between the figure and the description was probably due to the desire to bring other forms within the generic range. Thus he has figured *Hippolyte spinus*, which he makes the type of a separate division of the genus, with seven articuli to the carpos, so that the term multiarticulate was intended to mean any number of articuli more than one. In 1865, in a report to the British Association on the Marine Fauna of South Devon and Cornwall, the following passage written by myself occurs:—"Among the prawns we are enabled to add a new genus to the British fauna, namely, *Caridina* of Professor Milne-Edwards. In making this interesting addition we must remark that it is one of name only, since it is, we believe, the same that Dr. Leach described under the name of *Hippolyte varians*, which has remained misinterpreted. We have occasionally taken this species when dredging in Plymouth Sound, but never so abundantly as of late. We have previously observed the peculiar robust-looking first pair of pereiopoda, but it was not until recently we observed that it had the peculiar structural formation peculiar to the genus *Caridina*, in which the propodos articulates with the carpos, not at the centre, but at the infero-anterior angle, and thus appears as a partially dislocated joint."

The fact, however, that Leach made *Hippolyte varians* the type of the genus *Hippolyte*, compels me to restore it to its original position, especially since *Caridina* has only been recognised as a fresh-water form, and has the dorsal surface of the rostrum

smooth, and the carpos of the second pair of pereiopoda uniarticulate, according to Milne-Edwards' figure and description.

Dr. Stimpson [1] described a new genus founded on *Hippolyte acuminata*, Dana, under the name of *Verbius*, in which he placed *Hippolyte varians* as one of the recognised typical forms. This arrangement has been followed by Heller,[2] for he figures *Hippolyte varians*, Leach, as *Verbius varians* ; by Miers,[3] by Mr. J. S. Kingsley in his list of North American Crustacea,[4] and in his revision of the genera of Crangonidæ and Palæmonidæ,[5] and more lately by Professor Sars.[6] Dr. Stimpson establishes his genus *Hippolyte* on Fabricius' species of *Cancer aculeatus*, which corresponds with the forms of Milne-Edwards' third division of *Hippolyte*, in which also falls Sowerby's species of *Cancer spinus*. The latter species Kingsley [7] regards as the type of the genus *Hippolyte*. It is to be regretted that neither Stimpson nor Kingsley gave priority to Leach's definition of *Hippolyte*,[8] and which was founded on the species known as *Hippolyte varians*, in 1815. In the same volume in which this definition appeared, Sowerby's prawn was named *Alpheus spinus*[9] by Leach, and therefore at that time it was not recognised as belonging to *Hippolyte*, and it was not until he published the twenty-ninth plate of his Malacostraca Podophthalmia Britannica, a work which came out in parts between 1815 and 1817, that Sowerby's *Cancer spinus* was named *Hippolyte sowerbæi*.

Undoubtedly *Hippolyte varians*, Leach, and *Cancer spinus*, Sowerby, belong to two distinct genera, a fact that was probably recognised by Leach himself when he placed the latter, under the name of *Hippolyte sowerbæi*, in a second division of *Hippolyte*. This arrangement was followed by Milne-Edwards, who divided *Hippolyte* into three divisions, placing *Hippolyte varians* in the first, and *Hippolyte sowerbyi* in the third division.

Extended research has undoubtedly justified the division of the genus, upon purely anatomical grounds, into distinct genera.

When Leach first described the genus he had only one specimen to classify, and that was sent to him by Montagu from Devonshire, and this specimen he states to be the type of the genus. The specimen that he had named *Alpheus spinus*, the " Cancer spinus " of Sowerby, he evidently saw approached nearer to the new genus *Hippolyte* than to *Alpheus ;* he therefore made a division and arranged it within the genus upon grounds which would not now be accepted, namely, the number of teeth on the dorsal surface of the telson, the number of articuli of the second pair of pereipoda and the presence of a synaphipod on the mandible.

[1] *Loc. cit.*
[2] *Loc. cit.*, taf. x. fig. 4.
[3] *Loc. cit.*
[4] *Bulletin Essex Inst.*, vol. x. p. 63.
[5] *Proc. Acad. Nat. Sci. Philad.*, p. 421, 1879.
[6] *Loc. cit.*
[7] *Loc. cit.*, p. 419.
[8] *Trans. Linn. Soc. Lond.*, vol. ix. p. 346.
[9] *Loc. cit.*, p. 347.

When Milne-Edwards published his Histoire Naturelle des Crustacés in 1837, there were twenty-two species of *Hippolyte* known, and these he classified under three distinct divisions, dependent upon the extent to which the dorsal carina extends posteriorly. To these Dana added five, arranged in two divisions, corresponding with the first and third divisions of Milne-Edwards, and classified on the same character, and many others have since been added by Stimpson, Heller, Kröyer, Sars, and other carcinologists. To these may be added the specimens in this collection which differ from the typical *Hippolyte* of Leach in more or less important anatomical features, but all of which have certain external characters in common that are visible on superficial examination.

The form and disposition of the branchiæ are shown in the following table—

	h	i	k	l	m	n	o
Pleurobranchiæ,	...	...	...	1	1	1	1
Arthrobranchiæ,	...	...	...	...	...	...	...
Podobranchiæ,	...	...	...	...	...	...	...
Mastigobranchiæ,	1	...	...	...	...	...	...

Observations.—The late Professor Kinahan in a paper on this genus,[1] says of *Hippolyte varians* :—" This species occurs in great numbers in the sand-pools among the Zostera banks at Sandycove, near Kingstown; spawns in May. The specimens vary remarkably and beautifully in colour; pink, red, salmon, emerald-green, cobalt-blue, gray, chocolate-brown, opal white, are among the prevailing tints; the ova of a chocolate-brown.

" It is remarkably sensitive of handling; in no case could I succeed in keeping it for over forty-eight hours in a tank, although specimens of *Crangon fasciatus* and *Mysis chameleon*, from the same locality, lived with me for days. A volume might be written on the forms of the beak of this species. I have figured (pl. x.) the best marked varieties, which occurred in the following proportions :—

" Plate x. fig 1.—*a*. Normal type; rostrum nearly straight; apex bidentate, directed upwards, upper tooth shortest; below, two teeth, the anterior much posterior to the upper tooth of apex; proportional frequency of occurrence, 63 per cent.

" Fig. 2.—*b*. Rostrum straight; apex tri-dentate, teeth directed forwards, upper and lower teeth nearly equal in length; below one tooth only; proportional frequency, 25 per cent.

" Fig. 3.—*c*. Rostrum strongly curved upwards, scimitar-shaped; apex tridentate, upper tooth slightly longer than the lower; below a single tooth; proportion, 8 per cent. *N.B.*—The whole animal is much slenderer than the normal type; query a *species ?*

[1] *Proc. Nat. Hist. Soc. Dublin*, 1857, p. 48.

"Fig. 4.—*d*. Rostrum straight; apex broadly truncated, directed forwards, quadridentate, apical teeth very minute; below, two teeth; proportion, 2 per cent.

"Fig. 6.—*e*. Rostrum straight; apex acuminate, *simple*, directed upwards; rostrum with two teeth below; one specimen out of 300 examined.

"Fig. 5.—*f*. Rostrum straight; apex bifid; rostrum with three teeth below, viz., one beneath apex and two closely approximated in the broadest portion of the rostrum; one specimen.

"All these specimens in addition have the basal superior tooth (characteristic of the species). Another curious form had the rostrum very much curved upwards, apex simple, and teeth below absent. These all were from the same pools,—in company with *Mysis chameleon*, *Carcinus mænas*, *Cancer pagurus*, and that strange Edriophthalmous Crustacea *Apseudes talpa*."[1]

Hippolyte bidentatus, n. sp. (Pl. CV. figs. 1, 2).

Carapace smooth, having the dorsal surface level with the rostrum, which is more than half the length of the carapace; upper margin armed with a small tooth, halfway between the orbital margin and the apex of the rostrum; the lower margin with a similar tooth a little in advance of that on the upper surface. Supraorbital tooth well developed. Pleon slightly curved at the extremity of the third somite, which is produced posteriorly in the median line; the fourth somite is dorsally smooth; the fifth is armed on the posterior margin with two sharp teeth, one on each side of the median line; sixth somite unarmed. Telson long, narrow, tapering, extremity truncate and furnished with a small spine at each angle, and another more important on its inner side.

The ophthalmopoda are about half the length of the rostrum.

First pair of antennæ only slightly longer than the rostrum.

Second pair having the scaphocerite subequal in length with the rostrum, and a flagellum that is about the length of the animal.

First pair of pereiopoda short and robust. Second pair a little longer than the preceding and more slender. Third, fourth, and fifth pairs longer than the first two, robust, and terminating in a strong unguis flanked on the inner side by numerous spinules.

Length, entire (male and female),	14 mm. (0·5 in.).
„ of carapace,	4 „
„ of rostrum,	3 „
Depth of carapace,	3 „
Length of pleon,	10 „
„ of telson,	3 „

[1] *Loc. cit.*, p. 47.

Habitat.—April, 1873, Atlantic Ocean; on Gulf-weed. Two specimens; one male, one female.

June 18, 19, 1873; between Stations 62 and 63. One specimen, female, laden with ova. Taken at the surface.

This species bears some resemblance to *Hippolyte varians*, Leach, of which Professor Kinahan in his observations above quoted says "A volume might be written on the forms of the beak of this species," and he figures six of the best marked varieties. In every variety, however, the two teeth on the upper line of the rostrum are constant, one near the base, the other subapical, while those on the lower margin are as frequently two as three, two being the typical number.

Dr. Leach figures his specimen as having three teeth on the upper surface of the rostrum, but the posterior of these I believe to be the supraorbital tooth on the distant side, brought into view, as is not uncommonly the case, in the examination of the animal under compression or by the strain induced by using a too low magnifying power. If this view be correct, as I think it is, then Milne-Edwards' species of *Hippolyte tenuirostris* approximates closely in form to the variety of *Hippolyte varians*, which Kinahan describes as varying remarkably in the form of the rostrum (see p. 590).

Our present species, *Hippolyte bidentatus*, has the rostrum about two-thirds the length of the carapace, and in the same line with its dorsal surface. It is not elevated anteriorly, but comes to a point of lanceolate form at the apex (fig. 2*c'*); it is armed on the upper surface near the centre with a single tooth, and on the lower with one also, which is a little in advance of that on the upper margin. A well-developed supraorbital tooth flanks the rostrum at the base, posterior to which the carapace is smooth. The first antennal tooth is small and not conspicuous, but the second is more distinct. The third somite of the pleon is slightly arcuate towards the posterior extremity, and projects in the median line over the dorsal surface of the fourth. The fourth somite is smooth, and so is the fifth in the median line, but on each side a slender tooth projects from the posterior margin. The sixth somite is smooth and cylindrical, about one and a half times longer than the fifth, and a little shorter than the telson, which is long, narrow, and tapering.

The ophthalmopoda are small, pyriform, without any appearance of an ocellus.

The first pair of antennæ (fig. 1*b*) has the first joint broad and stout, excavate on the upper surface to afford room for the ophthalmopod, distally armed on the outer side with a stout tooth, and carrying a strong stylocerite that is about half the length of the joint. The second and third joints are short, cylindrical, and subequal in length, the third is distally divided and supports on each lobe a short flagellum. The flagellum on the outer and upper lobe is the more robust, it is shorter than the peduncle, and is divided into about ten or twelve articuli. The lower distal margin of each

articulus, projects beyond the base of the next and supports a few simple hairs, while two fasciculi of membranous cilia stand on each. The lower and inner flagellum is longer and much more slender than the outer, and is divided into twelve or fifteen articuli, fringed at each articulation with minute hairs.

The second pair of antennæ is about the length of the animal and carries a scaphocerite that reaches beyond the extremity of the rostrum, the squamiform portion is square at the extremity and fringed with ciliated hairs, the outer margin is smooth, rigid, and armed with a tooth near the distal extremity.

The mandibles (fig. 1*d*) correspond with those of *Hippolyte varians*, and consist of a stout molar projection, obliquely truncate, and covered with minute teeth, hairs and spinules, and a psalistoma that is slightly curved, pointed, and serrate at the inner distal extremity.

The first pair of siagnopoda (fig. 1*e*) is three-lobed, the outer lobe being styliform, the style consisting of a long and nearly straight, sharp pointed spine. The second pair was not examined. The third pair (fig. 1*g*) consists of three foliaceous plates of great tenuity, fringed on the inner margin with ciliated hairs, the third plate supports a long, slender, two-jointed appendage; at the base of the first joint a membranous mastigobranchial lobe is attached.

The first pair of gnathopoda (fig. 1*h*) is six-jointed. The joints are broad and flat, and fringed on the inner and distal margins with stout hairs delicately ciliated, the terminal two joints are reflexed against the preceding; the second joint carries a stout and long basecphysis, terminating in a few obscure articuli and long and ciliated hairs.

The second pair of gnathopoda (fig. 1*i*) is of moderate length and tolerably robust. It consists of five joints and is pediform. The coxa is broad and short, and supports a double foliaceous appendage, as if it were the rudiment of a branchial plume; the basis supports a short and stout ecphysis that is about half the length of the next joint, which is long and robust, and probably represents the ischium and meros combined; the fourth joint is short and broader at the distal extremity than at the base, and supports a long, slightly tapering and curved joint that terminates in three or four short stout spines.

The first pair of pereiopoda (fig. 1*k*) is short and robust; the meros is armed with a sharp projecting process on the upper distal angle, which receives and supports the carpos when thrown back; the carpos is short, broader at the propodal extremity than at the meral, the upper margin projecting beyond the articulation and forming a hollow cup, in which the basal portion of the propodos falls when the limb is extended. The propodos articulates with the carpos at the lower angle, it is dilated on the upper surface, and is lodged in the hollow formed in the frontal wall of the carpos; the pollex is pointed and curved, and corresponds in form with the dactylos,

so as to make a long ovate chela, the margins of which are ornamented with several fasciculi of strong and simple hairs.

The second pair of pereiopoda (fig. 1*l*) corresponds with the typical form, it is scarcely longer but much more slender than the first, and the chela is small and ovate; the carpos is twice the length of the propodos and distally as broad, it is divided into three articuli, of which the middle one is the shortest, each of which supports one or two fasciculi of hairs. The three following pairs are robust and longer than the preceding.

Hippolyte projecta, n. sp. (Pl. CV. fig. 3).

The rostrum is broken just beyond the orbit. Dorsal crest armed with teeth, four of which are present, the posterior being placed on the gastric region. A supra-orbital tooth is situated on each side, in a line corresponding with the third tooth from the posterior one, and a slender antennal tooth. The pleon is but slightly elevated at the third somite, which dorsally projects over the fourth; the sixth equals in length the preceding two, and the telson is subequal in length with the sixth somite.

The ophthalmopoda (fig. 3*a*) are pyriform and furnished with an incomplete ocellus.

The first pair of antennæ (fig. 3*b*) is robust and has the peduncle armed with two teeth on the first joint and one on the upper surface of the second and third joints. The upper flagellum is stout and the lower one slender.

The second pair of antennæ has a scaphocerite that reaches beyond the extremity of the peduncle of the first pair. The flagellum is broken off short.

The second pair of gnathopoda is robust, fringed with short hairs, and reaches as far as the extremity of the scaphocerite.

The first pair of pereiopoda is robust and short, the carpos articulating with the propodos at the lower angle. The second pair of pereiopoda is wanting; the third pair is long and robust; the meros is armed with three teeth on the lower distal margin. The fourth and fifth pairs are shorter than the preceding, and smooth.

Length, entire (male),	22	mm. (0·8 in.).
„ of carapace,	6	„
„ of rostrum,	...	
„ of pleon,	16	„
„ of third somite of pleon,	4	„
„ of sixth somite of pleon,	4	„
„ of telson,	4·5	„

Habitat.—Station 49, May 20, 1873; lat. 43° 3′ N., long. 63° 39′ W.; south of Halifax, Nova Scotia; depth, 85 fathoms; bottom, gravel, stones; bottom temperature, 35°·0. One specimen, male (?). Dredged.

Spirontocaris,[1] n. gen.

Hippolyte, Leach, Malacos. Pod. Brit. (Division **).
„ Milne-Edwards, Hist. Nat. Crust., tom. ii., pp. 375, 378 (Divisions 2 and 3).
„ Bell, Brit. Stalk-eyed Crust., p. 283 (Part).
„ Dana, U.S. Explor. Exped., Crust., p. 565 (Division 2).
„ Stimpson, Proc. Acad. Nat. Sci. Philad., p. 102, 1860.

Carapace carinated and armed with teeth. Rostrum deep, laterally compressed and armed on the upper and lower margins with numerous strong teeth. Frontal margin having two supraorbital, one antennal and one fronto-lateral teeth. First pair of pereiopoda subequal, having the carpos not excavate at the anterior extremity. Second pair having the carpos seven-jointed. Branchiæ twelve.

The carapace is anteriorly carinated and produced to a laterally compressed rostrum, that is furnished with teeth on the upper and lower margins, and elevated to a crest over the gastric and frontal regions. The frontal region is armed with two supraorbital teeth and an antennal tooth, and one is situated at the infra-anterior angle of the carapace. The pleon is dorsally smooth, having the third somite arcuate and posteriorly produced in the median line over the fourth somite.

The ophthalmopoda are uniarticulate, pyriform, short; the ophthalmus being furnished with an ocellus.

The first pair of antennæ is but little longer than the rostrum, having the first joint of the peduncle slightly excavated, broadly expanded, and armed on the outer margin with a stylocerite that is subequal in length with the first joint of the peduncle. The second and third joints are cylindrical, and support two short unequally stout flagella.

The second pair is subequal in length with the animal, and has a scaphocerite that is armed with a tooth on the outer distal extremity.

The mandibles have a broad molar process that is curved at right angles to the apophysis; the psalistoma is rudimentary and not connected with the molar process; the synaphipod is small, feeble and two-jointed.

The first pair of gnathopoda is small, feeble, and of great tenuity; the carpos and propodos are compressed, dilated, and reflexed against the inner margin of the meros; the basis carries a long ecphysis and the coxa supports a mastigobranchial plate, to which is attached a small podobranchial plume.

The second pair of gnathopoda is subpediform and five-jointed, the terminal joint is longer than the preceding, and distally compressed, the basis furnished with a short ecphysis, and the coxa carries the rudiment of a mastigobranchia but no branchial plume.

The first pair of pereiopoda short, robust and chelate, having a carpos that is anteriorly as broad as the proximal extremity of the propodos. The second pair is more slender than the first, minutely chelate and unequal in length, having the carpos

[1] From σπείρων, a sower.

seven-articulate. The third, fourth, and fifth pairs are subequal in length, and resemble each other in form, they are moderately robust and terminate in a dactylos that is serrate on the inner margin and terminates in a double unguis.

The posterior pair of pleopoda is subequal in length with the telson, the outer ramus being furnished with a diæresis that is armed with a tooth at the outer margin, and the telson is dorsally smooth and dorso-laterally furnished with short spines on each side, and spines and hairs at the extremity.

The preceding description is taken from *Cancer spinus*, Sowerby, which is synonymous with *Hippolyte spinus*, Leach, and which the latter made the type of his second division of *Hippolyte*. But since Leach's definition was chiefly based on the variable feature of there being four instead of two spines on each side of the dorso-lateral surface of the telson, its position in the genus with *Hippolyte varians* cannot be maintained in the face of more important structural differences.

The branchiæ consist of six pairs arranged as in the annexed table :—

Pleurobranchiæ,	...	...	1	1	1	1	1
Arthrobranchiæ,	...	...	...	...	...	...	...
Podobranchiæ,	r	...	...	...	...	...	...
Mastigobranchiæ,	1	r	r	r	r	...	...
	h	i	k	l	m	n	o

Geographical Distribution.—North Atlantic Ocean and Arctic Seas.

Spirontocaris spinus (Sowerby) (Pls. CVI., CVII.).

Cancer spinus, Sowerby, Brit. Misc., 1806, pl. xxi.
Alpheus spinus, Leach, Trans. Linn. Soc. Lond., vol. xi. p. 244; Edin. Encyclop. Sup., vol. vii. p. 421.
Hippolyte sowerbæi, Leach, Malacos. Podophth. Brit., pl. xxxix. figs. 1, 10.
„ *sowerbœi*, Desmarest, Consid. sur les Crust., p. 223, pl. xxxix. fig. 1.
„ *sowerbyi*, Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 380.
Hippolyte spinus, Owen, Ross's Second Voyage for the Discovery of a North-West Passage, Append., p. lxxxiii., pl. iii. fig. 2.
„ „ Bell, Brit. Stalk-eyed Crust., p. 284.
„ „ White, A., Pop. Hist. Brit. Crust., p. 118, pl. ix. fig. 1.
„ *securifrons*, Norman, Brit. Assoc. Rep., 1861; Trans. Tyneside Field Club, p. 267, pl. xii. figs. 1, 7, 1862.
Hippolyte spina, Stimpson, Proc. Acad. Nat. Sci. Philad., 1869, p. 106.
„ „ Kingsley, Proc. Acad. Nat. Sci. Philad., 1879, p. 418.

Leach's definition is as follows :—"H. rostro alto obtuso supra multi-serrato apice emarginato serrulato; subtus unisonato."

Carapace dorsally carinated and armed with five large teeth, commencing close to the posterior margin. Rostrum armed with one or two large teeth and a serrature of several minute ones, terminating more or less abruptly posterior to a sharp apical point; lower margin deep anteriorly and armed with two large teeth, and a serrature of several

smaller ones near the apex. Frontal surfaces of the carapace furnished with two supra-orbital teeth, a well-developed antennal tooth, and another at the fronto-lateral angle. Pleon having the third somite dorsally arcuate and posteriorly produced over the fourth, but not elevated into a tooth.

The first account of this species was given under the name of *Cancer spinus*, in a figure and description by Mr. Sowerby in the British Miscellany 1806; this was followed by a short notice by Leach under the name of *Alpheus spinus*, in the Transactions of the Linnean Society for 1815 (?), and in 1817 by a figure with the details enlarged but with meagre description in his Malacostraca Podophthalma Britannica.

A fuller description was given by Milne-Edwards, but even this leaves out some very important points, so important that it appears to me to be impossible naturally to retain this species in the same genus with *Hippolyte varians*, which Leach states to be the type of *Hippolyte*.

As the species appears to have a very large area of distribution, it is highly desirable that we should have a clear idea of its form and anatomical details, inasmuch as it appears to bear largely upon the specific value of other forms, more particularly since it has erroneously been accepted as the type of the genus *Hippolyte* by Stimpson, Kingsley, and other authors.

Leach's figure[1] was from another and more perfect specimen, but was accompanied by only a meagre description. The rostrum is drawn enlarged (Pl. CVI. fig. 1), and stands at the anterior extremity of a conspicuous carina that extends to the posterior margin of the carapace; on the dorsal crest, posterior to the orbit, are five large teeth, anterior to which, commencing just above the orbital margin, and continuous on the rostrum, is a series of twelve small teeth, of which those near the centre of the series are the largest, and the most anterior terminates at a little distance behind the apex. The apex forms a cylindrical sharp pointed tooth, that is produced posteriorly as a lateral ridge on each side through the middle of the rostrum to the base, where it is strengthened and supported by two teeth, one above the other, on the inner angle of the orbit. The lower margin of the rostrum descends from the apex perpendicularly, and forms a broad, compressed plate, the anterior edge of which is furnished with several minute teeth and a larger one, and still more distantly with another separated from the rest, behind which the margin ascends, apparently to afford space for the freer movement of the ophthalmopoda.

The ophthalmopoda are uniarticulate, short, and pyriform (Pl. CVII. fig. *a*).

The first pair of antennæ is furnished with a broad and sharp pointed stylocerite, and supports two short, unequal flagella, that reach but little beyond the rostrum.

The second pair is furnished with a broad scaphocerite, armed on the outer distal extremity with a strong tooth.

[1] *Loc. cit.*

The second pair of gnathopoda has the terminal joint about three times the length of the penultimate, it is spatuliform and has the distal margin fringed with small spines.

The first pair of pereiopoda is short, robust and chelate; the carpos being as long as the palm of the propodos and subequal with the meros. The second pair is long and slender, minutely chelate, and has a carpos that is half as long again as the meros, and is divided into seven unequal articuli. The posterior three pairs of pereiopoda are short and robust, and have the propodal extremity of the carpos projecting over the articulation; the propodos is fringed with spines on the flexor margin, and the dactylos serrate and biunguiculate.

The rhipidura has the outer plates bisected by a diæresis, and the external margin armed with a minute spine. The telson is longer than the lateral plates, and is furnished with four dorso-lateral spinules, and terminally with two spines and a few hairs.

Bell's description and figure were evidently taken from the animal which is preserved in the collection of the British Museum.

Milne-Edwards' description was probably drawn from an Arctic specimen. It differs from the figure given by Leach in certain minute details; for instance, he says that the extremity of the rostrum is truncated ("tronqué au bout"), armed on the upper surface with four or five teeth on the carapace and seven or eight very small teeth on the rostrum, and on the lower with two teeth, the anterior of which is separated from the apex by some little teeth.

The third somite of the pleon posteriorly projects as a great hooked tooth, and the telson is furnished with four pairs of little spines.

Milne-Edwards' specimens are recorded from Greenland and Iceland. Sowerby obtained his from Scotland, Leach's came from the Firth of Forth, and Bell received two that were dredged by Mr. MacAndrew off the coast of Shetland.

Professor Owen figures and describes[1] this species as having the carapace armed with teeth from the posterior margin to the apex of the rostrum (Pl. CVI. fig. 2), they decrease gradually in importance anteriorly, and on the under margin there are two teeth without the small series shown in Leach's figure, and he remarks that the general form of the rostrum agrees with that figured by Leach, but that many have it simply emarginate at the apex and not serrulate. The third somite of the pleon in Professor Owen's figure has the dorsal surface projecting posteriorly in the median line as a strong and elevated tooth. This peculiar feature is made a specific character in the description of this species under the name of *Hippolyte sowerbyi* by Milne-Edwards,[2] and also in the description and figure of *Hippolyte spinus* by Bell,[3] who states that it is carinated, while Owen figures it as an elevated and prominent tooth, and Milne-Edwards says that it is prolonged in the form of a great hooked tooth which resembles "un bec de seiche" advancing above the following somite.

[1] *Loc. cit.* [2] *Loc. cit.* [3] *Loc. cit.*

Leach's original figure in the Malacostraca Podophthalma Britannica does not so represent it, but it is given in Sowerby's figure, and also in Adam White's, Professor Bell's, and Sir Richard Owen's.

The specimens in the Challenger collection have not this feature developed beyond that shown in Leach's figure, in which the central portion of the third somite is posteriorly produced above and lies closely in contact with the dorsal surface of the next succeeding somite. Many specimens were taken at the same station, which exhibit variations that are interesting and perhaps important in the value they may have in regard to the formation of specific character. A brief description of each variety is given below.

Spirontocaris spinus, var. α (Pl. CVI. fig. 1).

Carapace dorsally carinated and armed with four or five large teeth, and seven or eight very small ones on the rostrum, and with two teeth, sometimes a serrature, on the lower margin. Pleon having the third somite arcuate and posteriorly produced to a sharp point (Leach).

Spirontocaris spinus, var. β (Pl. CVI. fig. 2).

Carapace dorsally carinated and armed with six large teeth which begin nearly at the posterior margin of the carapace, and seven or eight small ones on the rostrum, and with three teeth and no serrature on the lower margin. Pleon having the third somite arcuate, and posteriorly produced and elevated to a large tooth (Owen, Milne-Edwards, Bell, Adam White).

Spirontocaris spinus, var. γ (Pl. CVI. fig. 3).

Carapace dorsally carinated and armed with teeth that commence about one-third the length of the carapace from the posterior margin, and continue in a regular and horizontal succession of eight to a short distance from the extremity of the rostrum, when they gradually and rapidly decrease in size, in a series of four, to a sharp pointed apex. The lower margin is armed with two or three teeth. The lower of the supra-orbital teeth is smaller than the upper. Antennal tooth well developed. Fronto-lateral tooth reduced to a point. Third somite of the pleon arcuate, and posteriorly produced to a point in the median line.

Spirontocaris spinus, var. δ (Pl. CVII.).

Carapace dorsally carinated and armed with five teeth, commencing rather more than one-third its length from the centre of the posterior margin, and the rostrum with seven or

eight smaller ones, of which the anterior four or five form a small serrature; the lower margin is armed with three teeth. Pleon having the third somite dorsally arcuate, and only slightly produced posteriorly in the median line and not elevated into a tooth.

Spirontocaris spinus, var. ε (Pl. CVI. figs. 4, 5, 6).

Carapace dorsally carinated and armed with five large teeth that commence about halfway between the orbital and posterior margins, and the rostrum with several smaller teeth, of which the anterior four form an abruptly descending serrature posterior to the sharp apex; the lower margin is armed with four teeth. The upper of the supraorbital teeth is larger than the lower.

The antennal tooth as well as that at the fronto-lateral angle is moderately produced. Pleon having the third somite arcuate, posteriorly produced in the median line, but not elevated to a tooth.

Spirontocaris spinus, var. ζ (Pl. CVI. fig. 7).

Carapace slightly carinated and elevated on the dorsum as well as on the rostrum, armed with fourteen teeth of equal proportions, the anterior being the smallest; under margin armed with six of equal size; supraorbital teeth well defined but small, as are also the antennal and fronto-lateral teeth. Pleon having the third somite arcuate and posteriorly produced in the median line, but not elevated to a tooth.

Spirontocaris spinus, var. η (Pl. CVI. fig. 8).

Carapace anteriorly carinated and armed with six or seven large teeth, the posterior four of which are smooth, the two anterior serrate, which character of teeth is persistent to the apex of the rostrum. Under margin armed with three smooth teeth. Supra-orbital teeth large.

The variety δ (Pl. CVII.) is the nearest approach in this collection to the form of the type.

The carina on the dorsal surface of the carapace commences on the cardiac region, and is furnished with five strong teeth, of which the most anterior is on a level with the orbital margin; beyond this point the rostrum is furnished with seven teeth, gradually decreasing in size anteriorly, the last four form an oblique serrature terminating within the extremity of the rostrum, which is produced to a strong, oblique, upwardly directed, rounded, sharp tooth, which is continued posteriorly as a ridge on each side of the rostrum to the orbital margin, where it is supported by two small teeth, one above the other. The lower

margin of the rostrum is deep and laterally compressed, and armed with three teeth, of which the anterior is the largest; between it and the apical tooth the margin is smooth, there being no small teeth, as shown and described in the type specimen.

The ophthalmopoda (Pl. CVII., *a*) are pyriform, gradually increasing in diameter from the articulation to the ophthalmus, which is connected with a small, well-defined ocellus at its upper and inner margin, and halfway between the latter and the articulation there is a prominent lobe or tubercle.

The first pair of antennæ (*b*) has the peduncle shorter than the rostrum, the first joint horizontally depressed and laterally expanded, the outer margin being increased by a wide stylocerite, the point of which reaches nearly to a level with the distal articulation of the second joint. The second joint is armed on the upper and outer angle with a slender sharp tooth; the third joint is short and carries two very unequal flagella, the upper and outer is short, thick and flattened, about half the length of the peduncle, to which it is attached by a very small pedicle, and suddenly terminates at the apex in a small, slender, and short extremity; the inner flagellum is short, slender, and thread-like, and is subequal with the upper and reaches a little beyond the apex of the rostrum.

The second pair of antennæ (*c*) carries a scaphocerite that is subequal with the length of the rostrum; it is broad at the apex, having the inner margin subparallel with the outer and densely fringed with long ciliated hairs, and the outer strengthened by a ridge that terminates in a subapical tooth.

The mandibles (*d*) have the molar process obliquely truncate, and bent at right angles to the apophysis; the psalistoma is reduced to a small tooth-like process of considerable tenuity that terminates in an oblique serrate extremity; the synaphipod originates close to the base of the psalistoma, and is small, feeble, and two-jointed, the terminal joint being fringed with hairs.

The first pair of siagnopoda (*e*) differs from that of *Hippolyte* in having the outer branch bilobed, and armed on one lobe with a single, sharp, robust spine, and with two on the other. The second pair of siagnopoda has the posterior portion of the large mastigobranchial plate larger than in *Hippolyte*, but is otherwise developed in the same form. The third pair (*g*) as well as the two pairs of gnathopoda (*h*, *i*) also resemble those of *Hippolyte* in form.

The first pair of pereiopoda (*k*) is robust, but the propodos is not much broader or longer than the carpos; it is ovate, and terminates in a chela in which the pollex is more slender than the dactylos. The carpos is about the same length as the propodos; it is narrower at the meral articulation than at the distal extremity, where the upper angle is cupped and produced slightly over the propodos. The meros is long; the ischium short and subequal with the basis; and the coxa carries a rudimentary mastigobranchia (*mb*), which terminates in a strong hook and is posteriorly fringed with a few simple hairs. The second pair of pereiopoda (*l*) is slender and chelate; it has the carpos nearly

half the length of the leg and divided into seven articuli, the first two of which are short, the third, fourth, and fifth being subequally long, the sixth short, and the seventh about the same length as the fifth. The fingers of the chela are a little shorter than the palm of the propodos, and the coxa is furnished with a rudimentary mastigobranchia, similar in form to that on the preceding pair, and corresponding with those on the following pereiopoda. The last three pairs of pereiopoda are simple, the dactylos being slightly curved and furnished with a few spines and a small tooth on the inner margin near the unguis (*m*).

The pleopoda are biramose.

The telson is nearly as long as the lateral plates of the rhipidura, posteriorly tapering and truncate, the distal margin being fringed with hairs, and bearing a spinule at each angle, and the dorsal surface bearing two rows of spinules, four in each row, which Leach thought sufficient to make a specific distinction

Length, entire,	35	mm. (1·3 in.).
„ of carapace,	10	„
„ of rostrum,	6	„
„ of pleon,	25	„
„ of third somite of pleon,	5·5	„
„ of sixth somite of pleon,	4	„
„ of telson,	7	„

Habitat.—Station 49, May 20, 1873; lat. 43° 3′ N., long. 63° 39′ W.; south of Halifax; depth, 85 fathoms; bottom, gravel, stones; bottom temperature, 35°. Numerous specimens of both sexes and all the varieties. Associated with *Spirontocaris spinus*. Dredged.

A peculiar parasitic Cirriped was found on this species which will be described by Dr. Hoek in the Appendix A to this Report.

Nauticaris, n. gen.

Carapace one-third the length of the animal, anteriorly compressed, dorsally crested, and produced to a well-developed rostrum, adorned with teeth on the upper and lower margins; orbital region without supraorbital teeth. Outer canthus defined by a small point; antennal tooth just behind the frontal margin, infero-lateral angle defined by a small point.

Pleon smooth, third somite slightly arcuate. Sixth somite but little longer than the fifth, and furnished with a movable spine at the posterior extremity of the lower margin, just in advance of the articulation of the rhipidura.

Telson tapering.

Ophthalmopoda pyriform and furnished with a small ocellus.

First pair of antennæ carrying a strong stylocerite and terminating in two moderately long flagella.

Second pair of antennæ long, slender, and furnished with a long, narrow and pointed scaphocerite.

Mandible having the molar process cylindrical, without a psalistoma, but furnished with a slender three-jointed synaphipod.

Second pair of gnathopoda very long, straight, projecting beyond the rostrum, four-jointed, the coxa carrying a short, almost rudimentary, mastigobranchia.

First pair of pereiopoda chelate, robust; carpos long, and articulating with the propodos in the middle. Second pair long and slender, minutely chelate; carpos long and multiarticulate. Posterior three pairs of pereiopoda simple, unguiculate, and fringed with spinules.

Pleopoda biramose, foliaceous; terminal pair having the outer ramus furnished with a diæresis.

The branchial arrangement corresponds closely with that of *Merhippolyte agulhasensis*, but there is an additional plume, as seen in the following table:—

Pleurobranchiæ,	...	1	1	1	1	1	1
Arthrobranchiæ,	1	1	1	1	1	1	...
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	1	r	r	r	r	r	...
	h	i	k	l	m	n	o

Geographical Distribution.—Southern area of the Atlantic and Indian Oceans.

Observations.—This genus may easily be recognised by such external features as the great length of the second pair of gnathopoda, and the small movable spine attached to the postero-inferior margin of the sixth somite of the pleon. From the appearance of Milne-Edwards' figure (*loc. cit.*, pl. xxv. fig. 8) I am inclined to believe that *Hippolyte marmoratus* of Olivier, Lamarck, and Milne-Edwards, and perhaps also *Hippolyte aculeatus* of Fabricius and Sabine, may belong to this genus.

Nauticaris marionis, n. sp. (Pl. CVIII.).

Carapace dorsally crested, laterally smooth, having no supraorbital, antennal, or hepatic tooth; produced to a strong laterally compressed rostrum, which is anteriorly deep, armed on the upper margin with from eight to twelve teeth, the posterior three of which stand upon the frontal crest posterior to the orbital notch, and with three upon the lower margin.

The ophthalmopoda are pyriform.

The first pair of pereiopoda is robust, the second pair slender and longer than the first, the carpos being long and numerously articulate.

The pleon is dorsally smooth and unarmed. Fifth somite short, and armed at its postero-inferior angle with a sharp pointed movable spine.

Telson tapering.

	Female.	Male.
Length, entire,	38 mm. (1·5 in.)	32 mm. (1·2 in.).
„ of carapace,	12 „	9 „
„ of rostrum,	8 „	7·8 „
„ of pleon,	26 „	23 „
„ of third somite of pleon,	5 „	5 „
„ of sixth somite of pleon,	4 „	3·5 „
„ of telson,	7·5 „	6 „

Habitat.—Station 144A, December 26, 1873; lat. 46° 48′ 0″ S., long. 37° 49′ 30″ E.; off Marion Island; depth, 69 fathoms; bottom, volcanic sand. Sixty-seven specimens; males and females, the former apparently predominating. Dredged. Some of the females were taken with ova attached, in which the embryo was far advanced in development.

Station 145, December 27, 1873; lat. 46° 43′ 0″ S., long. 38° 4′ 30″ E.; off Prince Edward Island; depth, 140 fathoms; bottom volcanic sand. Three specimens; males. Dredged.

Station 315, January 26, 1876; lat. 51° 40′ S., long. 57° 50′ W.; off the Falkland Islands; depth, 12 fathoms; bottom, sand, gravel. One specimen; male. Dredged.

The carapace is laterally smooth and free from any denticular ornamentations, excepting those which exist on the frontal crest and rostrum, and those on the frontal margin which mark the orbital and antennal regions. The dorsal surface culminates in a frontal carina that projects as a rostrum (fig. 2), which is armed on the upper surface with from eight to twelve teeth, the posterior situated on the gastric region and the anterior being subapical. The larger number of teeth appears to occur in the males and the smaller in the females. On the under surface there are three large teeth, the posterior being the largest, lying in advance of a deep excavation for the reception of the ophthalmopoda. The outer canthus of the orbit is defined by a tooth, and beyond it there exists an antennal tooth, from which the frontal margin of the carapace descends slightly forwards and forms a slightly projecting tooth at the junction with the inferior margin; the latter recedes posteriorly and downwards to form the branchial chamber.

The somites of the pleon are smooth, unarmed, and subequal in length; the third is slightly arcuate, rather more so in the males than in the females. The fifth somite is the shortest, and the sixth slightly the longest; the latter has the lateral walls confluent with the ventral surface of the somite, and is furnished at the postero-inferior angle with a movable spine (v) that, so far as my experience goes, is unique. It is broad and flat at the base and tapers to a sharp point; it appears to spring from a hollow space in the margin rather than being directly attached to it, it is slightly movable and fringed with ciliated hairs on the anterior margin only.

The telson (z) is rigid, tapers to a point, and is armed on each side of the dorsal surface

with three distant spinules, and with a long and a short one at each angle of the terminal extremity.

The ophthalmopoda (*a*) are nearly half the length of the rostrum, pear-shaped, and carry a small round ocellus, lodged in an excavation in the upper or posterior margin of the ophthalmus and connected with it.

The first pair of antennæ (*b*) carries a long and powerful stylocerite that is sharp pointed and reaches beyond the distal extremity of the first joint of the peduncle, the outer distal angle of which is armed with a small tooth; the second joint is shorter than the first and similarly armed; the third is still shorter and distally supports two unequal flagella. The outer flagellum is the shorter and more robust, and is only a little longer than the peduncle, the inner is very slender and longer than the carapace.

The second pair of antennæ is about the length of the animal and carries a scaphocerite (*c*) that reaches a little beyond the extremity of the rostrum, and gradually tapers from the base to the extremity, the distal tooth reaching, as a stiff sharp point, considerably beyond the foliaceous plate, which is fringed from base to apex on the inner margin with long ciliated hairs.

The mandible (*d*) has the molar process dentated and placed at a right angle to the apophysis; it carries a three-jointed synaphipod, but has no trace of a psalistoma.

The first pair of siagnopoda (*e*) is three-branched; the inner branch is narrow, the middle one broad, discoidal, and fringed on the distal and inner margins with short fur-like hairs, and the third or outer branch broad at the base and gradually narrowing to a truncated extremity, which is tipped with three strong hairs.

The second pair of siagnopoda (*f*) is five-branched; the inner branch is narrow, subcylindrical and tipped with long ciliated hairs; the second and third are subequal, broad, flat, foliaceous, and fringed on the inner margin with thickly planted short hairs; the fourth branch is short, tapering, smooth and rudimentary; the fifth is broad, flat and foliaceous, homologises with the mastigobranchial plates and projects anteriorly and posteriorly beyond the preceding joints, and is fringed with short hairs.

The third pair of siagnopoda (*g*) has the inner joint broad, flat, and fringed with hairs; the second projects to a long, tapering, multiarticulate flagellum, supported on the outer side at the base by a broad foliaceous plate fringed with hairs; at the base of this plate there is a two-lobed mastigobranchial plate, one lobe of which projects anteriorly and the other posteriorly.

The first pair of gnathopoda (*h*) is seven-jointed. The basal joints are broad; the coxa carries a discoidal mastigobranchia to which is attached a small podobranchial plume; the basis supports a long ecphysis that terminates in a multiarticulate extremity; the ischium, which appears to be fused with the basis, gradually narrows to the extremity, where it joins the meros, which is short and distally supports the carpos; the latter is reflexed upon itself and carries the propodos, which appears to coalesce with the

dactylos, and falls against the inner surface of the ischium, which is narrowed to receive it.

The second pair of gnathopoda (*i*) is very long and powerful, but only formed of four joints; the first or coxa is short, broad, and supports a small mastigobranchia (*i''*) which is somewhat rigid, sharp pointed, lies close against the joint, and is furnished near the distal extremity with two small, curved, converging, pointed teeth; the second joint is long and trigonate, it is probably formed by the union of the basis and ischium, but it shows no trace of an articulation, it is excavate at the base for the greater play of the oral appendages. The third joint is not half the length of the second, it is smooth and subcylindrical; the fourth is nearly equal in length to the three preceding, gradually tapers to an obtuse point, and is fringed with small spinules.

The first pair of pereiopoda is moderately long and tolerably robust, the propodos being about half as long again as the carpos and nearly twice the length of the dactylos, which is subequal with the pollex. The second pair of pereiopoda (*l*) is long and considerably more slender than the first pair, it has the carpos multiarticulate and much longer than the rest of the limb. The first, second, third, and fourth pairs of pereiopoda carry a small mastigobranchia similar to that which exists on the second pair of gnathopoda, and like it without a branchial plume. The fifth pair of pereiopoda resembles the two preceding, and like them terminates in a simple dactylos, but carries no mastigobranchia.

The pleopoda are biramose, the sixth pair (*v*), forming part of the rhipidura, is only a little longer than the telson; the margins are fringed with long hairs and the outer plate is furnished with a short, stiff spinule at the outer angle of the diæresis.

From the depths at which the specimens were taken it appears that although they live near the bottom they are not inhabitants of deep water.

Nauticaris futilirostris, n. sp. (Pl. CIX. fig. 1).

Carapace about one-fourth of the length of the animal; sides free from armature; dorsal surface carinated, crested and armed with two teeth on the frontal and gastric regions, and with three beyond on the rostrum, the extremity of which is elevated, with one tooth on the lower margin near the apex.

Pleon smooth, fifth somite short, sixth nearly twice its length.

Telson long and tapering.

Ophthalmopoda pyriform.

First antennæ short, robust; inner flagellum stout, outer slender.

Second antennæ as long as the animal, and furnished with a scaphocerite that is as long as the first antennæ.

Second gnathopod long and robust.

First pereiopod robust, carpos distally as wide as the propodos.

Length, 22 mm. (0·9 in.).

Habitat.—Station 233A, May 19, 1875; lat. 34° 38′ N., long. 135° 1′ E.; off Japan; depth, 50 fathoms; bottom, sand. One specimen; female, bearing ova. Dredged.

The carapace is smooth, slightly carinated on the frontal region, anteriorly produced to a slender rostrum that does not reach beyond the distal extremity of the peduncle of the first pair of antennæ; it is armed with five teeth on the upper margin, three of which stand on the frontal crest, the other two on the free portion of the rostrum, and with one on the lower margin near the apex, which terminates in a single, sharp, elevated point.

Pleon smooth, having the third and fourth somites gibbous, and the sixth somite short and furnished with a small tooth-like spine.

Ophthalmopoda long, pyriform; ocellus close to the margin of the ophthalmus.

First pair of antennæ having the peduncle about the length of the rostrum, and the flagella about equal in length to the peduncle. The inner and upper flagellum is very much more robust than the outer, and the basal joint of the peduncle is furnished with a sharp pointed stylocerite that reaches nearly to the extremity of the third joint.

The second pair of antennæ is furnished with a scaphocerite that is broad and rounded at the extremity, armed on the outer margin with a short strong tooth, and reaching beyond the distal extremity of the rostrum and nearly to that of the first pair of antennæ; it also carries a flagellum that is slender and about equal to the length of the animal.

The second pair of gnathopoda is long, robust, and reaches beyond the distal extremity of the rostrum.

The first pair of pereiopoda is tolerably robust, and has the carpos long and cylindrical, and the propodos still longer, and articulating near the middle of the carpos. The second pair is long and slender, the propodos being equally so with the carpos. The three posterior pairs of pereiopoda are not long but tolerably robust, having the anterior distal extremity of the carpos projecting to a strong process or blunt tooth over the base of the propodos; the dactylos is bi-unguiculate, the concave or posterior margin being furnished with several spines.

The telson is tapering, subequal in length to the lateral plates of the rhipidura, and tipped with two or three long spines.

Observations.—This species corresponds closely with Stimpson's description of *Hippolyte gracilirostris*,[1] which he found among stones at a depth of about 2 fathoms, in the Gulf of Hakodadi in North Japan, but it differs in several details. Stimpson describes his species as "having the carapace smooth, with an anterior very short carina; the anterior margin being armed with only a pterygostomianal [frontolateral] tooth. The rostrum being slender, straight, a little deflexed, short, not reaching

[1] *Proc. Acad. Nat. Sci. Philad.*, 1860, p. 103.

beyond the last joint of the peduncle of the first pair of antennæ, six equal teeth on the upper surface, the posterior two being on the carapace; apex bi-denticulate, inferior margin being armed with two teeth a little behind the apex."

In the Challenger specimen there are only five teeth on the dorsal crest and rostrum, of which two are posterior to the orbital margin, and three stand on the rostrum, and only one near the apex on the lower margin. The apex is also slightly turned upwards, whereas in Stimpson's description it is said to be straight and bifid, with two teeth on the lower margin. He also describes the frontal margin of the carapace as having no tooth but that which defines the frontal from the lateral margin, whereas in *Nauticaris futilirostris* the outer canthus of the orbit is defined by a small point or tooth; another and larger one corresponds with the first antenna, another but rather smaller one with the second antenna, and one still smaller is situated at the fronto-lateral angle.

The second pair of gnathopoda also appears to be longer in our specimen than in the one described by Stimpson, and the animal is more robust and thick, but this might in part be due to its being a female gravid with ova.

It may also be compared with Dana's species, *Hippolyte brevirostris*,[1] which was taken at Dungeness in the Straits of De Fuca, Oregon, but which has only four teeth on the upper margin of the rostrum and none on the lower.

Nauticaris unirecedens, n. sp. (Pl. CX. fig. 1).

Carapace anteriorly crested and produced to a rostrum that is armed on the upper surface with seven equidistant teeth, and one placed further back on the dorsal surface over the gastric region.

Length, entire,	23 mm. (0·9 in.).
,, of carapace,	7 ,,
,, of rostrum,	3·5 ,,
,, of pleon,	16 ,,
,, of third somite of pleon,	3·5 ,,
,, of sixth somite of pleon,	2·5 ,,
,, of telson,	4·5 ,,

Habitat.—Hong Kong. One specimen; female.

The animal is robust in appearance, the dorso-frontal surface being slightly compressed and elevated to a small carina that is armed on the gastric region with one well-developed tooth, in front of which there is a space without any tooth. On the frontal region, posterior to the orbital margin, a series of seven teeth commences and continues on the

[1] Dana, *loc. cit.*, p. 566, pl. xxxvi. fig. 5.

rostrum nearly to its apex; on the lower surface of the rostrum near the distal extremity there are three teeth, behind which the inferior margin is excavate for the more free play of the ophthalmopoda, a condition that gives a somewhat arcuate appearance to the rostrum. The frontal margin has the orbit nearly conicident with the first antennal tooth, whence it descends vertically to the infra-lateral margin, the angle being defined by a small tooth; there are no teeth on the orbital or hepatic regions.

The pleon is smooth and dorsally rounded, the somites are subequal, the fifth and sixth being the shortest.

The telson is dorsally flattened, and laterally armed with two small, distantly situated spinules, placed a little within the margins; it gradually tapers to the extremity, which is furnished with a row of long and slender hairs.

The ophthalmopoda are cylindrical and about half the length of the rostrum, the stalk being as stout as the ophthalmus.

The first pair of antennæ is biramose; the peduncle reaching considerably beyond the distal extremity of the rostrum; the first joint is longer than the ophthalmopod, and supports a strong stylocerite that reaches to its extremity; the second joint is about half the length of the first, and extends beyond the extremity of the rostrum, and the third joint is short, being scarcely more than half the length of the second.

The second pair of antennæ is about once and a half the length of the animal and tapers to a delicately fine point, and the peduncle supports a scaphocerite that extends a little beyond the peduncle of the first pair of antennæ.

The mandibles and other oral appendages could not be thoroughly examined without destroying the single specimen.

The second pair of gnathopoda is moderately robust and four-jointed, the terminal joint, reaching beyond the distal extremity of the peduncle of the first pair of antennæ, is hirsute and tipped with three strong spinules.

The first pair of pereiopoda is moderately robust; the propodos is subequal in length, but not much broader than the carpos, the hand is long, ovate, and terminates in a chela that has subequal fingers; the pollex and dactylos are convergent, meet at some little distance within the points, and are about half the length of the palm of the propodos. The second pair of pereiopoda is long, slender and minutely chelate; the carpos, which forms about half the length of the limb, is multiarticulate. The fourth pair of pereiopoda is robust and nearly as long as the second; the propodos is armed with a row of gradually enlarging spinules on the posterior margin, and the dactylos is slightly curved and biunguiculate. The third and fifth pairs are broken off at the basisal joint.

The four anterior pairs of pereiopoda support a small mastigobranchia below the margin of the carapace.

The pleopoda are biramose, the first pair having the inner branch smaller than the

outer, and between this pair of pleopoda are two teeth, one on each side of the ventral median line.

The posterior pair has the branches subequal in length and but little longer than the telson, the basal joint articulates with the sixth somite, in a deep excavation at the posterior angle.

Observations.—This species so nearly corresponds with *Nauticaris marionis* in all conveniently accessible parts that I have placed it in the same genus, although it does not possess the small peculiar spinule at the postero-inferior angle of the sixth somite, which may be only of specific value. Only one specimen of this species appears to have been taken during the voyage.

Hetairus,[1] n. gen.

Rostrum horizontal, armed on the upper and lower margins with teeth, flanked at the base with a supraorbital tooth, below the orbit with an antennal tooth, and at the fronto-lateral angle with a small point.

The ophthalmopoda are large, pyriform, and furnished with a small ocellus.

The first pair of antennæ is short and biflagellate.

The second pair carries a large scaphocerite and a flagellum as long as the animal.

The mandibles consist of the molar process, a psalistoma, and a two-jointed synaphipod.

The first two pairs of siagnopoda correspond generically with those of *Hippolyte* and *Spirontocaris*. The third pair carries a two-lobed mastigobranchia.

The first pair of gnathopoda carries a mastigobranchia and a rudimentary podobranchial plume.

The second pair of gnathopoda carries a rudimentary mastigobranchia, but neither branchia nor basecphysis.

The first three pairs of pereiopoda carry a rudimentary mastigobranchia, but the posterior two pairs are without it. The first pair is robust and chelate. The second is slender, long and minutely chelate, the carpos being seven-articulate.

The branchiæ consists of five pleurobranchial plumes, which may with the other parts be tabulated as follows :—

Pleurobranchiæ,	...	...	1	1	1	1	1
Arthrobranchiæ,	...	...	...	...	...	...	...
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	r	r	r	r	...	...	...
	h	i	k	l	m	n	o

Geographical Distribution.—Atlantic Ocean.

Observations.—This genus has a peculiar interest. In many points it possesses

[1] From ἑταῖρος, an associate.

features that associate it with the genus *Spirontocaris*, and in others it has characters that correspond with those of *Hippolyte*.

Like *Hippolyte*, as restricted to correspond to Leach's type, it has a horizontal rostrum, one supraorbital and one antennal tooth, and the first pair of pereiopoda has a slight tendency to have the propodal extremity of the carpos elevated and cup-like.

Like *Spirontocaris* it has three teeth on the lower margin of the rostrum, and carries a small tooth at the distal extremity of each joint of the first pair of antennæ. The mandible carries a two-jointed synaphipod. The second pair of pereiopoda has the carpos seven-articulate, and the three anterior pairs of pereiopoda carry a rudimentary mastigobranchial appendage. It differs from both *Hippolyte* and *Spirontocaris* in having no appendage attached to the basis of the second pair of gnathopoda; and in having no teeth on the ventral surface of the pereion.

Stimpson's species of *Hippolyte rectirostris*, from the north of Japan, corresponds closely with, and probably belongs to this genus.

Hetairus gaimardii (Milne-Edwards) (Pl. CIX. fig. 2).

Hippolyte gaimardii, Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 378.

"Rostrum straight, commencing near the middle of the carapace, very slightly elevated, and extending nearly as far as the extremity of the scaphocerite, slightly enlarged below, and armed above with six widely spaced teeth, of which three are on the carapace; three teeth upon the inferior margin. Scaphocerite long and oval, reaching far beyond the second pair of gnathopoda, of which the last joint is styliform. Pereiopoda as in Sowerby's *Hippolyte* (*Spirontocaris spinus*). Third somite of the pleon less strongly toothed; four pairs of spines on the telson. Length about 18 lines."—(Milne-Edwards.)

Anteriorly robust; posteriorly slender. Rostrum armed on the upper margin with six teeth, and on the lower near the apical extremity with three.

Length, entire,	31	mm. (1·2 in.).
„ of carapace,	8·5	„
Depth of carapace,	7	„
Length of rostrum,	6	„
„ of pleon,	22·5	„
„ of third somite of pleon,	6·5	„
„ of sixth somite of pleon,	5	„
„ of telson,	5	„

Habitat.—Station 49; lat. 43° 3′ N., long. 63° 39′ W.; south of Halifax, Nova Scotia; depth, 85 fathoms; bottom, gravel, stones; bottom temperature, 35°. One specimen; female. Dredged.

The body of the animal is anteriorly robust and continues so to the extremity of the third somite of the pleon, behind which it suddenly narrows and becomes smaller.

The carapace is nearly as deep as its length from the orbital to the postero-dorsal margin, and is dorsally carinated from near the posterior margin, where the elevation is broad, but anteriorly it gradually narrows to the apex of the rostrum. The rostrum is about two-thirds the length of the carapace, and is armed with six small, subequal teeth, the posterior of which stands upon the gastric region, and the others are subequally distant from each other and from the sharp apical extremity. The under surface is slightly dilated anteriorly and armed with three small, anteriorly directed, sharp teeth. A strong ridge runs from the apex of the rostrum to the orbital margin, and above the orbit there is a well-defined tooth from which an elevation passes back, traceable to the pyloric region. The orbit is defined at the outer canthus by a sharp angle, the margin then proceeds directly outwards and is armed with a well-formed antennal tooth, and then passes down perpendicularly to the fronto-lateral angle, which is defined by a small sharp tooth.

The pleon is anteriorly as broad and deep as the carapace. The first somite has the anterior division distinctly defined, the posterior being dorsally short, laterally broad, and overlapping the postero-lateral margin of the carapace. The second somite has the anterior division well defined from the posterior. The third somite is posteriorly compressed, dorsally arcuate, and posteriorly produced in the median line; the three following somites become somewhat suddenly narrower, and continue tapering posteriorly to the extremity of the telson.

The ophthalmopoda are large and pear-shaped, the ophthalmus being broad and carrying a small round ocellus, situated in contact with its posterior margin.

The first pair of antennæ has the peduncle subequal in length with the rostrum; the first joint is excavate on the upper surface for the reception of the eye, armed on the outer side with a sharp stylocerite, and has the extremity furnished with two short sharp teeth, one on the outer, the other on the upper surface; the next two joints are short and cylindrical, the distal being the smaller, and both are armed with a sharp tooth on the upper distal surface. The flagella at the extremity are short and unequal, the upper being the stouter and reaching but little beyond the extremity of the rostrum.

The second pair of antennæ carries a scaphocerite that is nearly as long as the first pair of antennæ, and a long flagellum that is broken off in the type specimen.

The mandibles (fig. 2*d*) have a cylindrical molar process, a flattened psalistoma, and a two-jointed synaphipod.

The first and second (fig. 2*f*) pairs of siagnopoda are unlike those of *Spirontocaris*.

The third pair carries a large, bilobed mastigobranchia and a broad basecphysial plate of extreme tenuity, from the inner surface of which there springs a filiform extension. The base of the joint is broadly expanded on the inner ridge, the margin of which is

thickly fringed with short, stiff hairs, between which and the ecphysis stands a two-jointed continuation.

The first pair of gnathopoda (fig. 2*h*) corresponds both with that of *Hippolyte* and that of *Spirontocaris*, and supports a small mastigobranchia and a rudimentary podobranchia.

The second pair of gnathopoda is pediform, five-jointed, and robust; it differs from the same appendage in both *Hippolyte* and *Spirontocaris* is having no basecphysis, but it supports a rudimentary mastigobranchia.

The first pair of pereiopoda is short and robust, the carpos being long and distally increasing in diameter, and produced anteriorly a short distance above the propodos; the propodos is long, slightly curved, and not broader than the distal extremity of the carpos; the pollex and dactylos are short. The coxa supports a rudimentary mastigobranchial appendage. The second pair of pereiopoda is long, slender, and minutely chelate, having the carpos seven-articulate; the coxa carries a rudimentary mastigobranchial stump. The third pair is long and simple; it has the carpos long, cylindrical, and distally produced above the propodos, which is also long and cylindrical and slightly spinulous on the posterior margin; the dactylos is short, robust and serrate. The coxa supports the stump of a mastigobranchial appendage. The fourth and fifth pairs of pereiopoda resemble the third in general structure, but do not carry even the rudimentary stump of a mastigobranchial appendage.

The pleopoda are short, broad, biramose and foliaceous.

The rhipidura is strong and well developed, but the telson in our unique specimen is broken.

Observations.—This species appears to be identical with Milne-Edwards' description of *Hippolyte gaimardii* in all points, excepting that in our specimen the second pair of gnathopoda reaches as far as the extremity of the scaphocerite, whereas in his description it is described as being shorter. Milne-Edwards' specimens were obtained near Iceland. It also corresponds very closely with *Hippolyte rectirostris* of Stimpson,[1] which was taken in deep water off the Port of Hakodadi, at the northern extremity of Japan.

Hetairus tenuis, n. sp. (Pl. CIX. fig. 3).

Rostrum about two-thirds the length of the carapace, narrow immediately in advance of the frontal margin, and deepening slightly anteriorly, superiorly armed with six teeth inferiorly with three.

Ventral surface of each of the three posterior somites of the pereion armed with a pair of teeth.

Pleon smooth, third somite slightly gibbous and dorsally produced in the median line.

[1] *Proc. Acad. Nat. Sci. Philad.*, January 1860, p. 102.

The telson is subequally long with the outer plates of the rhipidura.

The ophthalmopoda are pyriform, and furnished with an ocellus.

The first pair of antennæ has the peduncle subequal with the rostrum, and carries a sharp and slender stylocerite that equals the length of the first joint; terminal flagella about the same length as the peduncle.

The second pair of antennæ carries a scaphocerite that is broad at the extremity and reaches beyond the apex of the rostrum, and a flagellum that is shorter than the animal.

The second pair of gnathopoda reaches as far as the extremity of the scaphocerite.

The first pair of pereiopoda is short and moderately robust, the second pair is long, slender and subequal, and the three posterior pairs terminate in a biunguiculate dactylos.

Length, entire,	31	mm. (1·2 in).
„ of carapace,	7	„
„ of rostrum,	6	„
„ of pleon,	24	„
„ of third somite of pleon,	6·5	„
„ of sixth somite of pleon,	4·1	„
„ of telson,	5·5	„

Habitat.—Station 49; lat. 43° 3′ N., long. 63° 39′ W.; south of Halifax, Nova Scotia; depth, 85 fathoms; bottom, gravel, stones; bottom temperature, 35°·0. One specimen; male. Dredged.

The animal is slender in general form, and has the rostrum straight and in the same horizontal line with the dorsal surface of the carapace, and about two-thirds of its length, measured in the median line from the orbital to the posterior margin. It is armed on the upper margin with six small teeth, of which two are posterior to the orbital margin; on the lower margin there are three near the distal extremity. The supraorbital and antennal teeth are well developed, but that at the fronto-lateral angle is small.

The ophthalmopoda are pear-shaped and about half the length of the rostrum.

The first pair of antennæ has the peduncle extending, by the length of the last joint, beyond the extremity of the rostrum; each joint is armed with a strong tooth and the two flagella are short and unequal. The second pair of antennæ is rather longer than the animal, and the scaphocerite reaches beyond the terminal joint of the peduncle.

The second pair of gnathopoda extends to a point subequal with the scaphocerite.

The first pair of pereiopoda is short and robust; the carpos is nearly as long as the propodos; posteriorly it is narrow and distally as broad as the propodos, and overrides it on the upper margin. The second pair of pereiopoda is long, slender, and has the carpos seven-articulate.

The pleon does not suddenly narrow at the third somite, which is dorsally arcuate and posteriorly only slightly produced in the median line.

The rhipidura is well developed and has the telson subequal in length with the lateral plates; the telson is dorso-laterally armed with four small pairs of spinules.

Observations.—This species was taken at the same station as the preceding, with which it was associated. It corresponds with it in many points, but differs in the more slender general appearance of the animal, in the slender and feeble character of the armature on the rostrum, and in the absence of any carina-like elevation on the dorsal surface of the carapace posterior to the gastric region; and in the presence of three pairs of teeth on the ventral surface of the posterior somites of the pereion.

Hetairus debilis, n. sp. (Pl. CIX. fig. 4).

Rostrum about half the length of the carapace; armed on the dorsal surface of the frontal crest with four small teeth, and without any on the rostrum proper, which terminates in a sharp pointed apex; under surface slightly broader near the apical extremity and armed with three minute teeth.

Length, entire (minus telson),	16	mm.	(0·6 in.)
„ of carapace,	5	„	
„ of rostrum,	2·5	„	
„ of pleon (minus telson),	11	„	
„ of third somite of pleon,	3	„	
„ of sixth somite of pleon,	3	„	
„ of telson,	?	„	

Habitat.—Station 49, May 20, 1873; lat. 43° 3′ N., long. 63° 39′ W.; depth, 85 fathoms; bottom, gravel, stones; bottom temperature, 35°. Fifteen specimens, the majority of which were young and the sex not readily determined; of those full grown, two are females and one male. Dredged.

This species corresponds in many points with the preceding, but has the rostrum shorter and more slender. The upper surface is armed near the base with four small teeth, of which two are posterior to the orbital margin; nearer the apical extremity there are two small lobes, apparently the rudiments of more perfect teeth; there are three small teeth on the under surface. The ventral surface of each of the posterior three somites of the pereion is armed with a pair of teeth.

The rhipidura is broken off.

This specimen appears to me to form a link in a series by which extreme forms are united, or it may be only a younger form of *Hetairus tenuis*.

Chorismus,[1] n. gen.

Carapace less than one-third of the length of the animal, posteriorly rounded, anteriorly compressed, and produced to a long rostrum that is dilated on the under surface anteriorly, and posteriorly excavated to receive the ophthalmopoda. Armed with teeth on the dorsal crest and on the rostrum, above and below. No tooth on the orbital region. Orbit defined by a tooth at the outer canthus. Frontal margin having an antennal tooth, and one at the infero-lateral angle of the carapace.

Pleon smooth, third somite arcuate, sixth somite twice the length of the fifth.

Telson long, narrow and tapering.

Ophthalmopoda pyriform, ophthalmus orbicular, ocellus imperfectly defined.

First pair of antennæ biramose, first joint furnished with a long, sharp stylocerite.

Second pair of antennæ having a long, slender flagellum, and a long scaphocerite that has a rounded foliaceous extremity, and is armed with an outer distal tooth.

Mandible furnished with a small and sharp pointed psalistoma, and a biarticulate synaphipod placed at the base of the molar process, where it meets the apophysis.

First pair of gnathopoda furnished with a long basecphysis.

Second pair of gnathopoda without a basecphysis.

First pair of pereiopoda robust and chelate. Second pair long, slender, and minutely chelate, having the carpos long and multiarticulate. Posterior three pairs of pereiopoda subequal, robust, and terminating in a sharp pointed unguiculate dactylos, which is armed with stout spines on the posterior margin.

Branchiæ consisting of seven pairs; five pairs of pleurobranchiæ of nearly equal prominence, one pair of small arthrobranchiæ, and one of podobranchiæ. The podobranchiæ are attached to the mastigobranchial plate of the first pair of gnathopoda.

In external appearance this genus corresponds with *Merhippolyte*, but it is distinguishable from it by the character and number of the branchiæ, in which respect it more nearly resembles *Spirontocaris*, as may be seen in the following table :—

Pleurobranchiæ,	...	...	1	1	1	1	1
Arthrobranchiæ,	...	1	...	...	...	...	...
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	1	r	r	r	...	...	...
	h	i	k	l	m	n	o

It differs from *Hippolyte* in the absence of the supraorbital tooth, in having no ecphysis to the second pair of gnathopoda, in having three instead of four small mastigobranchiæ following the first pair of gnathopoda, and in having the carpos of the second pair of pereiopoda multiarticulate, instead of triarticulate.

Geographical Distribution.—There is only one species in the Challenger collection, and that is abundant in the South Indian Ocean.

[1] χωρισμός, separation.

Chorismus tuberculatus, n. sp. (Pl. CX. fig. 2).

Carapace smooth, anteriorly produced to a long, slightly upturned rostrum, armed on the upper surface near the base with four teeth, and on the under surface with seven; apex bifid. Frontal margin with a strong first antennal tooth, and a small tooth at the fronto-lateral angle.

Pleon smooth, except the third somite, which dorsally carries a strong tubercle, hence the specific name.

The telson is long, tapering, and furnished with two distinct spines on the dorso-lateral margin.

Length, entire,	69 mm. (2·7 in.).
„ of carapace,	16 „
„ of rostrum,	24 „
„ of pleon,	53 „
„ of third somite of pleon,	9 „
„ of sixth somite of pleon,	13 „
„ of telson,	14 „

Habitat.—Station 145A, December 27, 1873; lat. 46° 41′ S., long. 38° 10′ E.; off Marion Island; depth, 310 fathoms; bottom, volcanic sand. Fifteen specimens, the males appearing to predominate; none of the females bear ova. Dredged.

The main interest of this species arises from its external resemblance to the genus *Merhippolyte*, while its branchiæ approximate to those of *Spirontocaris*.

The mandibles do not exactly correspond with those of either of these two genera, nor does the second pair of gnathopoda, which carries no branch.

The rostrum is very long, and gradually curves upwards towards the apex, which terminates in a double point. Above the orbit, commencing posteriorly over the gastric region, there are four anteriorly pointed, sharp, low lying teeth, the anterior of which is in advance of the eye, and beyond it the rostrum is smooth to the apex. The lower margin is armed with six or seven teeth, which gradually increase in size and depth posteriorly. The orbit is defined by a small point or tooth at the outer canthus on the inner side of the first antennal tooth.

The ophthalmopod (fig. 2*a*) is pear-shaped, being smaller at the base than at the ophthalmus, and attached to the somite by a small but distinct pedicle; the ophthalmus is hemispherical, and has no distinct ocellus connected with it.

The first pair of antennæ is short, the peduncle reaching a little beyond the extremity of the eyes. The outer and more robust flagellum scarcely reaches to the extremity of the rostrum, and the inner, which is slender and filamentous, reaches a little beyond it.

The second pair of antennæ carries a strong scaphocerite, which is strengthened on the outer margin by a strong ridge, terminating in a sharp-pointed tooth that falls short

of the extremity of the appendage; the peduncle terminates in a flagellum that equals in length the entire animal from the orbit to the extremity of the telson.

The mandible (fig. 2*d*) has the psalisiform process developed as a small, pointed organ, of but little apparent utility; the molar process is strong, broad, and square, and the synaphipod is three-jointed, the first or basal joint being the shortest.

The siagnopoda bear a general resemblance to those of *Hippolyte*, as also does the first pair of gnathopoda. The second pair of gnathopoda is subpediform as in *Hippolyte*, but does not carry a basecphysis.

The first pair of pereiopoda is short, robust, and chelate, having the carpos nearly as long and stout as the propodos; the propodos is subcylindrical, about twice the length of the dactylos. The second pair is long, slender, terminates in a minute chela, and has the carpos long and multiarticulate. The posterior three pairs are moderately long and robust and terminate in a sharp pointed dactylos, armed on the inner margin with three fine teeth.

The pleopoda have the peduncle posteriorly longitudinally marginate and distally produced to a point, terminating in two subfoliaceous rami fringed with hairs. The first pair in the male has the outer branch more rigid than in the other pairs, and the inner is shorter.

The rhipidura has the outer plates subequal with the inner, and armed on the outer margin with a strong ridge, terminating in a sharp tooth that coincides with the outer extremity of the diæresis.

Many specimens of this species were taken by the dredge in the Southern Indian Ocean. They vary in size from 1 to 3 inches, and none of them were carrying ova. The females appear to differ from the males only in the varying length of the branches of the first pair of pleopoda.

Tozeuma serratum, A. Milne-Edwards,[1] which was taken at a depth of 40 fathoms off Barbados, belongs, I think, to this genus. It resembles *Chorismus tuberculatus* in general aspect, in the ornamentation of the rostrum and dorsal crest, and in having the first pair of antennæ and the second pair of pereiopoda short. It is excluded from Stimpson's genus *Tozeuma* by having the carpos of the second pair of pereiopoda multiarticulate instead of triarticulate, as described by that author.

Merhippolyte, n. gen.

In general appearance this genus resembles *Spirontocaris*, but carries no teeth above the orbit. The frontal margin has an antennal tooth, and the fronto-lateral angle is produced to a point.

The ophthalmopoda are pyriform, the ophthalmus globular and furnished with a distinct ocellus.

[1] Recueil de Figures de Crustacés nouveaux ou peu connus, avril 1883.

The first pair of antennæ carries two flagella.

The second pair of antennæ has a round, pointed scaphocerite armed with a tooth on the outer margin and carries a long flagellum.

The mandibles have a small psalistoma and a three-jointed synaphipod, distinct from the molar process.

The first pair of pereiopoda is chelate and has the carpos continuous with the propodos. The second pair of pereiopoda is long, slender, minutely chelate, and has the carpos multiarticulate. The three posterior pairs of pereiopoda are simple and well developed.

The pleon has the third somite dorsally arcuate and slightly produced posteriorly.

The telson is tapering and dorsally furnished with two or three lateral pairs of solitary spinules.

The branchial plumes are more numerous in this genus than in *Spirontocaris*, there being five pairs of arthrobranchiæ in addition to the pleurobranchiæ, as shown in the annexed table, which represents the condition in *Merhippolyte agulhasensis*.

Pleurobranchiæ,	...	1	1	1	1	1	1
Arthrobranchiæ,	...	1	1	1	1	1	...
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	1	r	r	r	r	r	...
	h	i	k	l	m	n	o

It is an interesting and instructive feature in this genus that so great a variation in the character of the branchiæ exists with such small external change.

Geographical Distribution.—The typical species *Merhippolyte agulhasensis* was first taken on the Agulhas Bank, which lies between the Southern Indian and Atlantic Oceans, about 100 miles south of the Cape of Good Hope. A second species, *Merhippolyte orientalis*, was found near the Arrou Islands, south of New Guinea.

Merhippolyte agulhasensis, n. sp. (Pl. CX. fig. 4).

Carapace having the dorsal surface anteriorly projected to a slender rostrum, that is nearly as long as the carapace; armed on the upper margin with five teeth, the most posterior standing on the gastric region and the anterior near the middle of the rostrum, and on the lower margin with five smaller teeth, remote from one another.

Pleon smooth. Telson tapering.

Ophthalmopoda pyriform.

First pair of antennæ with both flagella about as long as the animal.

Second pair of antennæ with flagellum longer than the animal, having the scaphocerite as long as the rostrum.

First pair of pereiopoda short, strong, and chelate. Second pair long, slender, and chelate, the carpos being multiarticulate.

Length, entire,	. . . . .	44 mm. (1·7 in.).
,,	of carapace, ...	11 ,,
,,	of rostrum, ...	11 ,,
,,	of pleon, ...	33 ,,
,,	of third somite of pleon, ...	8 ,,
,,	of sixth somite of pleon, ...	7·5 ,,
,,	telson, ...	9 ,,

Habitat.—Station 142, December 18, 1873; lat. 35° 4′ S., long. 18° 37′ E.; south of the Cape of Good Hope; depth, 150 fathoms; bottom, green sand; bottom temperature, 47°. Five specimens; one female, the others undetermined. Dredged.

The carapace is smooth, dorsally carinated in front of the gastric region, and anteriorly produced to a rostrum that is subequal with the dorsal surface of the carapace; it is armed on the upper surface with five large teeth, the posterior standing on the gastric region, and the anterior, which is smaller than the others and a little in advance of them, situated about half-way between the orbital margin and the apex of the rostrum. The frontal margin has a long spine-like tooth, corresponding with the outer margin of the first pair of antennæ, and a very minute one at the fronto-lateral angle of the carapace.

The pleon is smooth, but slightly compressed, having the third somite posteriorly arcuate. The sixth somite is once and a half as long as the fifth; the anterior three are posteriorly rounded at the infero-lateral angle, and the three posterior produced to a sharply pointed angle.

The telson is subequal in length with the sixth somite, and armed laterally on the dorsal surface with three small spinules on each side.

The ophthalmopoda (fig. 4*a*) are short, subglobular, pyriform, and furnished with a circular ocellus, situated within an indentation of the margin of the ophthalmus, with which it is continuous.

The first pair of antennæ has the first joint of the peduncle depressed on the upper surface, and laterally armed with a long pointed stylocerite, that reaches to the extremity of the joint, which is fringed with short hairs; the two succeeding joints are short and cylindrical, and terminate in two long, slender flagella, that are about equal in length to the entire animal.

The second pair of antennæ is once and a half as long as the whole animal, and carries a scaphocerite that reaches as far as the extremity of the rostrum, and is subapically furnished with a tooth on the outer margin.

The epistoma is deep, and the mandibles, which are embedded within the oral orifice, have the large molar prominence compressed and dentated. The psalistoma is reduced

to a rudimentary condition, being only a short, flat point, and beside it stands a three-jointed but rather feeble synaphipod, that is fringed with a few hairs.

The first pair of siagnopoda is two-branched, one branch being broad, foliaceous, and fringed with hairs.

The first pair of gnathopoda has a long basecphysis and a mastigobranchial plate of extreme tenuity, with a small podobranchial plume attached.

The second pair of gnathopoda (fig. 4*i*) is long, robust and four-jointed; the first joint, which is the coxa, is short, the second is long, the third and fourth long and distally fringed with spinules. It has no basecphysis attached, but supports a rather rudimentary mastigobranchia that originates in a broad discoidal base, and has no branchial plume.

The first pair of pereiopoda is short, strong, and chelate, having the basis and ischium anteriorly produced on the lower margin to a prominent tooth; the coxa supports a rudimentary mastigobranchial appendage, as do all the other pereiopoda except the posterior pair. There is a pair of arthrobranchial plumes attached to the articulation of the second pair of gnathopoda and anterior four pairs of pereiopoda. There are six pleurobranchiæ, of which the posterior is the largest and the anterior the smallest. The second pair of pereiopoda is long, slender, and chelate, having the carpos long, flexible, and multiarticulate. The three succeeding pairs are long and moderately robust, they have the meros posteriorly fringed with spines; the propodos is longer than the carpos, and terminates in a short and slightly curved dactylos, that has the posterior margin sharply serrate.

Merhippolyte orientalis, n. sp.

Rostrum armed on the upper surface with five or more strong teeth, of which the posterior corresponds with the gastric region, and is smaller than the others. The apex of the rostrum is broken off, and its length cannot therefore be determined.

The ophthalmopoda are pyriform, and as long as the first joint of the peduncle of the first pair of antennæ.

Length, entire,	32 mm. (1·2 in.).
„ of carapace,	8. „
„ of pleon,	24 „

Habitat.—Station 191, September 23, 1874; lat. 5° 41′ 0″ S., long. 134° 4′ 30″ E; off New Guinea; depth, 800 fathoms; bottom, green mud; bottom temperature, 39°·5. One imperfect specimen. Trawled.

This specimen is much damaged, but the broken rostrum reaches beyond the extremity of the first joint of the first pair of antennæ, otherwise I should have considered it to be *Hippolyte spinifrons* of Milne-Edwards.[1] It is somewhat difficult to determine exactly

[1] *Loc. cit.*, vol. ii. p. 377.

what tooth this author means by "*les épines suborbitaires.*" If it refers to that which we call the antennal tooth, it differs from our species which has that tooth short in relation to the length of the ophthalmopod; but as it is not impossible that it was intended to mean the stylocerite, which in its proper position lies under the orbit and supports the eye, then it corresponds with the description (dépassant les yeux et atteignant le tiers antérieur du rostre).

Amphiplectus.[1]

Resembles *Merhippolyte*, but differs in the proportional size of the second pair of gnathopoda, the first two pairs of pereiopoda, and in the form of the mandible.

The second pair of gnathopoda is short, feeble, and furnished with a long and slender basecphysis.

The first pair of pereiopoda is also short, feeble and chelate. The second pair is more than twice the length of the first, and has the basal joint robust and the distal joints slender; the carpos is long, divided into numerous small articuli, and the terminal chela is slender and feeble.

The mandible has the molar process and psalistoma confluent, the former being the lower and robust portion, and the latter forming the upper and more thin division of the anterior serrate margin, from the base of which a two-jointed synaphipod arises.

The pleopoda are subfoliaceous, biramose, and lanceolate in form.

The rhipidura has the outer plate a little longer than the telson, rounded at the extremity and armed on the outer margin with a sharp tooth and a spinule at the extremity of the diæresis.

The telson is long, slender, tapering to the extremity and distally truncate.

The branchiæ consist of a series of pleurobranchiæ and arthrobranchiæ as shown in the annexed table :—

Pleurobranchiæ,	...	...	1	1	1	1	1
Arthrobranchiæ,	...	1	1	1	1	...	...
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	r	...	...	...	...	...	...
	h	i	k	l	m	n	o

Observations.—This genus bears a strong resemblance to *Merhippolyte*, from which it differs in the feebleness of the limbs, especially the anterior ones.

It also resembles *Nematocarcinus* in the peculiar articulations that exists between the ischium and meros, although the great length of the legs is wanting. The carpos in the first two pairs of periopoda is also similar, but in the three posterior pairs this

[1] $\alpha\mu\Phi\iota\pi\lambda\eta\kappa\tau o\varsigma$, compressed on both sides.

joint is shorter, being but little longer than the propodos, and the dactylos also differs in form. The branchial apparatus, so characteristic of that genus, is also similar.

The antennæ have the terminal flagella, especially those of the first pair, short.

There is also a resemblance to *Merhippolyte* in the long and curved carpos of the second pair of pereiopoda. So great is this resemblance that it was only after a very close inspection and the action of a reagent that I became convinced of its multiarticulate condition.

This genus is at present represented by only one species, and unfortunately there is only a solitary specimen in the collection.

Amphiplectus depressus, n. sp. (Pl. CX. fig. 3).

Carapace short, dorsally depressed on the gastric region, anteriorly produced to a rostrum that is nearly as long as the dorsal surface, and crested on the frontal region with numerous small teeth, whence it is smooth to the apex, which is forked; the under surface is armed with five or six small teeth near the base.

The first pair of antennæ is short and slender.

The second pair is about half as long as the animal, and carries a scaphocerite that reaches as far as the extremity of the rostrum.

The first two pairs of pereiopoda are chelate, slender, and unequal in length, the first being short and chelate, the second long and minutely chelate. The posterior three pairs are short, and stronger than the preceding.

Length, entire,	30	mm. (1·2 in.).
„ of carapace,	9	„
„ of rostrum,	7	„
„ of pleon,	21	„
„ of third somite of pleon,	3	„
„ of sixth somite of pleon,	5	„
„ of telson,	5·5	„
„ of second antenna,	15	„
„ of scaphocerite,	7	„
„ of second gnathopod,	9	„
„ of first pereiopod,	12·5	„
„ of second pereiopod,	23	„
„ of third pereiopod,	15	„

Habitat.—Station 122, September 10, 1873; lat. 9° 5′ S., long. 34° 50′ W.; off Pernambuco; depth, 350 fathoms; bottom, red mud. One specimen, female. Trawled.

The carapace is short, rather less than one-fourth the length of the animal; the dorsal surface is depressed over the gastric region, and anteriorly produced to a slender

rostrûm that is nearly as long as the carapace, armed on the frontal crest with a series of twelve small spinules, and on the under surface with six minute teeth, the apex is unequally forked, having a small tooth above and a large one below. There is no tooth over the orbital region, but the first antennal tooth is produced to a short point, and at the base of the second antennæ is a sharp tooth, but none is present at the fronto-lateral angle.

The pleon is more than twice the length of the carapace, measured from the orbit to the extremity of its dorsal surface, and from the posterior dorsal surface of the carapace to the extremity of the telson. The somites of the pleon are deeper than the lateral walls of the carapace, but they lessen in height after the fourth somite, all of which, including the fifth and sixth, are rounded at the postero-lateral margin. The sixth somite is nearly twice the length of the fifth, and a little longer than the telson, which is narrow and tapers to the extremity.

The ophthalmopoda are short, the ophthalmus is orbicular, but scarcely larger in diameter than the peduncle, and possesses no ocellus.

The first pair of antennæ is short; the first joint of the peduncle is about equal in length to the two succeeding, it is excavate on the upper surface to receive the ophthalmopod, and is furnished with a stylocerite that is broad at the base, sharp pointed, and of great tenuity, reaching quite to the extremity of the joint; the second and third joints are short, the last, which is the shortest, supports two multiarticulate flagella, that are unequal in diameter, the outer being the larger, and neither longer than the peduncle.

The second pair of antennæ is about two-thirds the length of the animal, and carries a scaphocerite that is rounded at the extremity, and armed at the outer angle with a sharp tooth that reaches beyond the end of the scaphocerite, and is subequal with the length of the rostrum.

The mandible (fig. 3*d*) has the molar process and cutting margin of the psalistoma continuous and serrate. The molar process is thick, and the psalistoma thin, and at their base a two-jointed synaphipod originates.

The other oral appendages have not been examined.

The second pair of gnathopoda (fig. 3*i*) is pediform, five-jointed and slender; the coxa supports a sharp and rigid tooth that I take to be the rudiment of a mastigobranchial appendage, and a small arthrobranchial plume; the basis is short, and supports a long and slender ecphysis, that is nearly as long as the appendage to which it belongs. The next joint is long, and probably represents the ischium and meros united; the carpos is half the length of the preceding joint, and is greater in diameter distally than at the meral extremity; the propodos is long, slender, and bluntly pointed, and fringed with long hairs, as is also the carpos and meros on the inner margin.

The first pair of pereiopoda is a little longer than the second pair of gnathopoda. It is slender and chelate; the ischium and meros are united by an overlapping articulation;

the carpos is long and slender, but of greater diameter at the propodal extremity, where it is armed on the under surface with a sharp, spine-like tooth; the propodos is long and slender, not being broader than the distal extremity of the carpos; the fingers impinge closely and correspondingly. The second pair of pereiopoda is twice as long as the first. The ischium and meros are together as long as the first pair of pereiopoda, and are much more robust, but have no tooth at the lower distal angle; the carpos and propodos become suddenly more slender, and when at rest lie folded against the more robust basal joints, with which they agree in length; the carpos is long, slender, and cylindrical, and when extended is curved in an inverse direction to the basal joints, with which it corresponds when reflexed; the propodos is about a third of the length of the carpos, of somewhat less diameter, slightly curved, and terminates in a slender, long, fringed chela. The third pair of pereiopoda is not so long as the second, but more robust throughout, and is armed with a sharp tooth at the infero-distal extremity of the meros; the carpos is long and cylindrical, and so is the propodos, but not so long as the carpos; the dactylos is stout, bidentate, and embedded in a brush of hairs. The fourth and fifth pairs resemble the third, but are each successively shorter.

The pleopoda are short, stiff, subfoliaceous, and biramose.

The rhipidura is strongly developed, the telson being nearly as long as the lateral plates, the outer of which is armed with a tooth and a spinule corresponding with the extremity of the feebly marked diæresis, and the extremity and inner margin are fringed with long hairs.

The only specimen obtained is a female, laden with numerous eggs of a slightly ovate form and of moderate size.

Our specimen was taken off Barra Grande, on the eastern coast of South America. M. Guérin-Méneville[1] figures a species under the name of *Hippolyte elongatus*, that corresponds much with this species, particularly in the form of the rostrum, which, however, is long and smooth on the lower margin, whereas in *Amphiplectus depressus* there are six small but well defined and widely separated teeth.

The habitats of these two species are in the same geographical region, and it is not improbable that they may belong to the same genus.

Family PANDALIDÆ.

Animal laterally compressed. Carapace not more than one-third the length of the animal, and anteriorly produced to a long and slender rostrum, more or less abundantly armed with teeth or spines. The ophthalmopoda are well developed but not remarkable for size. The first antennæ are biflagellate. The second are long and carry a well-developed scaphocerite. The second pair of gnathopoda is pediform. The first pair of

[1] Atlas, Zoologie de l'Ile de Cuba, pl. ii.

perciopoda is not chelate. The second pair is chelate and has the carpos multiarticulate. The succeeding three pairs are simple. The pleopoda are biramose. The rhipidura is well developed and strong.

This family contains several genera and connects the Hippolytidæ with the Palæmonidæ.

Several of the genera in this family much resemble each other in general appearance, but possess special features that offer means of ready distinction, and may conveniently be arranged under the following heads :—

Heterocarpus, A. Milne-Edwards.

Carapace laterally and dorsally carinated. Rostrum armed with teeth only, both above and below.
First pair of antennæ having a rudimentary stylocerite.
Second pair of pereiopoda unequal in length.

Plesionika, n. gen.

Carapace smooth, carinated anteriorly. Dorsal crest and rostrum armed with teeth only, above and below.
First pair of antennæ having a well-developed and pointed stylocerite.
Second pair of pereiopoda unequal in length.

Nothocaris, n. gen.

Carapace smooth. Dorsal crest armed with spines and teeth. Rostrum armed with teeth above and below.
First pair of antennæ having a large and pointed stylocerite.
Second pair of pereiopoda unequal in length.

Pandalus, Leach.

Carapace smooth. Frontal crest and rostrum armed on the upper surface with movable spines only, and on the lower with teeth.
First pair of antennæ not longer than the carapace, and furnished with a stylocerite that has the apex rounded.
Second pair of gnathopoda without a basecphysis.
Second pair of pereiopoda unequal in length.

Pandalopsis, n. gen. (A. Milne-Edwards *in litt.*).

Like *Pandalus*, but having the first pair of antennæ twice the length of the carapace.

Chlorotocus, A. Milne-Edwards.

Carapace smooth, dorsally carinate. Frontal crest and rostrum serrate above and below.

Second pair of pereiopoda having the carpos biarticulate, and uniform in length.

Dorodotes, n. gen.

Like *Chlorotocus*, but having the carpos of the second pair of pereiopoda six-articulate.

Heterocarpus, A. Milne-Edwards.

Heterocarpus, A. Milne-Edwards, Ann. d. Sci. Nat., sér. 6, t. xi. art. 4, p. 8, 1881.

The carapace is laterally compressed, dorsally carinated, anteriorly elevated into a crest, and produced to a long rostrum that is generally armed with teeth on the upper and lower margins. The lateral surface of the carapace is traversed longitudinally by two or more carinæ. On the ventral surface of the sixth somite of the pereion there are two small processes.

The pleon is generally laterally compressed, frequently carinated, and dorsally armed on some one or more of the somites with denticular processes, but there are never any on the sixth somite, which is constantly smooth and short and produced posteriorly on each side at the base of the telson to small sharp teeth.

The telson is long and laterally compressed, and has the longitudinal dorso-lateral angle reduced by the lateral compression, and is generally armed with small spines, equidistant from each other but varying in number.

The ophthalmopoda are short, and the ophthalmus is orbicular.

The first pair of antennæ has the peduncle short, the first joint being furnished with a pointed stylocerite, and terminating in two long and slender flagella, the outer of which, especially in the males, is the more robust for a considerable distance, and then suddenly narrows to the diameter of the inner branch; the latter is the longer, but both only reach a little beyond the distal extremity of the rostrum.

The second pair of antennæ carrying at the anterior and inner angle of the first or coxal joint a long and narrow phymacerite, the external orifice of the green gland. The second joint is produced to a sharp tooth on the inner anterior margin, and there is

another on the outer margin; the distal extremity supports a long narrow scaphocerite that varies somewhat in form in different species, and the peduncle terminates in a long and slender flagellum.

The mandibles are deeply inserted within the oral margins, and consist of a narrow molar process, a psalistoma, and a slender three-jointed synaphipod.

The first pair of siagnopoda is three-branched, and resembles the same appendage in *Pandalus*.

The second pair is two-branched and furnished with a large, broad, mastigobranchial plate; the inner branch is double, short, broad and foliaceous, and the outer short and narrow. The mastigobranchia is produced anteriorly, rounded posteriorly, and bordered with long hairs; it differs from the same organ in *Pandalus* in not being prolonged posteriorly.

The third pair of siagnopoda is five-branched, the first or inner branch is broad, foliaceous, and fringed with cilia; the second is long, broad and membranous, and of extreme tenuity; the following branches are long, cylindrical, and tapering. A large mastigobranchial plate, which is divided into an anterior and a posterior portion, is attached to the first or coxal joint.

The first pair of gnathopoda is short, flat, and formed of six joints; the first joint is short, and supports a short, broad, mastigobranchial plate with a small podobranchial plume attached; the second or basisal joint is long, flat on the inner side and rounded on the outer, where it carries a long two-jointed branch, the first joint of which is subcylindrical and the second multiarticulate. The ischium and meros are short, longer on the outer than on the inner margin, and consequently form a curve with each other. The carpos is broader than long, and terminates in a small propodos that corresponds with the carpos, and has the inner or distal margin thickly furred with hairs.

The second pair of gnathopoda is long and pediform, having the basisal joint furnished with a slender, single-jointed, tapering branch; the meros is longer than the ischium, the carpos and propodos are subequal, and the dactylos is wanting. This appendage only carries the rudiment of a mastigobranchial plate but no podobranchial plume; a small arthrobranchia is attached to the membranous articulation.

The first pair of pereiopoda is long and pediform, scarcely so robust as the second pair of gnathopoda, but much resembling it. It has the dactylos rudimentary, the propodos long and slender, but shorter than the carpos and equally subcylindrical. It has no branch attached to the basis or second joint, and only a small and rudimentary mastigobranchia attached to the coxa, and is without a podobranchial plume. The second pair of pereiopoda is unequal in length, the right being the shorter and more robust; the right hand is also a little the larger. Both appendages have the carpos long and multiarticulate, that on the left being the more slender and extensively multiarticulate, and carry a rudimentary mastigobranchia but no podobranchial plume. The three

following pairs are similar to each other and not very long. The carpos is shorter than the propodos and the dactylos is small, slender, and armed; the posterior margin of these three pairs is generally fringed with sharp spine-like teeth.

The pleopoda have the basal joint long, broad, and obliquely compressed, the posterior distal angle being considerably produced, beyond which there are two long, narrow, subfoliaceous plates fringed with hairs, of which the inner is furnished with a compressed stylamblys but without cincinnuli. The first pair differs from the others in having the inner branch short and furnished with a very short stylamblys. The posterior pair helps to form the rhipidura, and it has the peduncle short and the branches long and foliaceous. The outer plate is strengthened on the outer side, and longitudinally fluted and furnished with a distinct diæresis, the outer angle of which is armed with a single tooth and spine.

Each pair of pereiopoda except the posterior is furnished with a rudimentary mastigobranchia, and all the branchial plumes increase proportionately very much in size as they proceed backwards. The branchial arrangement is shown in the following table:—

Pleurobranchiæ,	...	...	1	1	1	1	1
Arthrobranchiæ,	...	1	1	1	1	1	...
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	1	r	r	r	r	r	...
	h	i	k	l	m	n	o

Observations.—This genus has been recently established by A. Milne-Edwards for two specimens taken in the West Indies. Those in the Challenger collection are from the seas around the Philippine Archipelago, and two of them appear to correspond very closely with the occidental species.

In structural details they correspond very closely with the genus *Pandalus*, but differ considerably in external form, on which Milne-Edwards has apparently relied for the generic characters. "The carapace," he says, "is carinated above, and the pleon carries upon some of its somites a strong median carina that terminates posteriorly in a point, but the legs are destitute of palps" (basecphyses). Features of this kind are very liable to vary, as may be seen by our species *Heterocarpus gibbosus*, in which there is neither carina nor tooth on the dorsal surface of the pleon, and yet this species undoubtedly belongs to the same genus as *Heterocarpus ensifer*, A. Milne-Edwards.

Geographical Distribution.—The first specimen (*Heterocarpus ensifer*) of this genus was taken by the Challenger in 1874, near the Philippine Islands, and one very like, if not identical with it, was taken in the West Indies, near Barbados, by the American Expedition in 1878. About the latter time *Heterocarpus oryx*, A. Milne-Edwards, was taken in the Gulf of Orleans, and another almost identical, *Heterocarpus alphonsi*, was found by the Challenger near the Philippine Islands; a slender variety of the same

species was taken near the south part of Japan, and a smooth or less dentated form off Manila in the Philippine Sea.

The depth at which the oriental specimens were taken ranged from 250 to 700 fathoms, while those from the West Indies were got in 218 and 955 fathoms respectively.

Heterocarpus dorsalis, n. sp. (Pl. CXI.).

Resembles *Heterocarpus oryx*, A. Milne-Edwards, but may be distinguished from it by having only eight teeth on the dorsal crest and upper margin of the rostrum and seven on the lower, by the first pair of antennæ being longer than the rostrum, and the second pair twice the length of the animal.

Length, entire,	80 mm. (3·1 in.).
„ of carapace,	25 „
„ of rostrum,	35 „
„ of pleon,	55 „
„ of third somite of pleon,	15 „
„ of sixth somite of pleon,	11 „
„ of telson,	13 „

Habitat.—Station 194, September 29, 1874; lat. 4° 34′ 0″ S., long. 129° 57′ 30″ E.; off Banda Island; depth, 200 fathoms; bottom, volcanic mud. Two specimens; females. Dredged.

The carapace is traversed longitudinally by five distinct carinæ, of which the central is anteriorly produced to a rostrum that is half as long again as the carapace, and is armed with eight well-defined teeth, the posterior being on the gastric region; the lower margin of the rostrum is furnished with seven strong teeth, of which the posterior is considerably in advance of the orbital margin.

The second or upper lateral carina commences at the orbital margin just above the tooth of the outer canthus, and passes a little outwards and downwards along the surface of the carapace to within a short distance of the posterior margin, at which point it is deflected at right angles inwards towards the median carina, posterior to which it meets the corresponding bend of the carina on the opposite side. The lower lateral carina commences at the fronto-lateral angle of the carapace, which is anteriorly produced to a long strong tooth, and traverses the carapace in a line parallel with the preceding ridge, and terminates gradually, being lost at a short distance from the posterior margin. The infero-lateral margin of the carapace is also traversed by a stout ridge that commences on the inner side of the fronto-lateral tooth, and is continuous to the posterior margin. There is moreover a small carina between this marginal ridge and the lower lateral; it is very short, commencing at the posterior edge of the carapace and disappearing at a point which corresponds with the coxa of the posterior pair of pereiopoda.

The pleon has the anterior two somites dorsally smooth, but a carina commences abruptly at the anterior margin of the third and continues on the fourth and fifth somites, and on each of these three it is posteriorly produced to a sharp tooth. The sixth somite is longitudinally flat or channelled dorsally, and is furnished at the posterior margin on each side of the median line with a strong tooth, and with a smaller one at the postero-lateral angle.

The telson (z) is long, tapering, dorsally channelled and has the lateral margins depressed, and armed with three small spines, and the extremity with two.

The ophthalmopoda are short and pyriform, scarcely reaching beyond the apex of the first antennal tooth at the outer canthus of the orbit.

The first pair of antennæ (*b*) has the stylocerite reaching quite to the distal extremity of the first joint; the second and third joints are cylindrical and carry two unequal flagella, the upper and outer being stout for about two-thirds the length of the rostrum, from which point it suddenly becomes slender and extends a little beyond the extremity of the rostrum. The inner and lower branch is slender from the base, and is about once and a half as long as the rostrum.

The second pair of antennæ (*c*) carries a scaphocerite that is about half the length of the rostrum, the outer margin is rigid and terminates in a sharp tooth that falls considerably short of the distal extremity of the inner or submembranous portion, the margin of which is fringed with hairs.

The mandibles (*d*) are placed deeply within the oral cavity; the molar process is cylindrical, and at the angle with the apophysis the psalistoma projects as a long, flat, curved, rigid attachment, dentated only at the extremity; at its base there arises a broad triarticulate synaphipod fringed with hairs and not longer than the molar process.

The first pair of siagnopoda is a small three-branched appendage; the outer branch is short and apically serrate, the median is broad, flat, and fringed on the inner, distal margin with numerous spines of different thicknesses and a few ciliated hairs, the inner branch is lunate, and distally and externally fringed with spines and hairs.

The second pair of siagnopoda (*f*) is formed on the inner side by two broad, short plates, distally fringed with numerous spines, a small central branch, narrowing suddenly towards the extremity, and a broad, flat, submembranous mastigobranchial plate that projects anteriorly, considerably beyond the other branches, and expands posteriorly into a broad, flat plate, rounded at the margins, and fringed with long ciliated hairs, all radiating outwards and anteriorly.

The third pair of siagnopoda (*g*) has a large squamous branch on the inner side, a central three-jointed branch, narrow and subcylindrical, and at its base a broad, squamous square-shaped plate, from the inner margin of which springs a long and slender flagellum; each branch is more or less fringed with ciliated hairs.

The first pair of gnathopoda (*h*) is subpediform and short; the propodos is reflexed

against the carpos; the dactylos is broad, short, and continuous with the distal extremity of the propodos; the coxa supports a short mastigobranchial plate and a branchial plume; the basis carries at its distal outer extremity a short ecphysis; each joint is thickly fringed with hairs.

The second pair of gnathopoda (*i*) is six-jointed and pediform; the coxa carries a rudimentary mastigobranchia and a tuft of long hairs, and the basis a rudimentary ecphysis reduced to a tubercle; the ischium is long, and the meros longer and more slender; the carpos is a little shorter than the meros, and fringed with short stiff hairs; the propodos is terminal, shorter than the carpos, cylindrical, tapering, and fringed with short hairs.

The first pair of perciopoda (*k*) closely resembles the second pair of gnathopoda, but is more slender. The second pair (*l*) has the right and left appendages unequal in length, owing to the carpos on the left side being nearly as long again as that upon the right, both are minutely chelate, the chela on the left side being smaller than that on the right. The posterior three pairs correspond in length, form and character, and are peculiar from the great length of the meros as compared with the ischium (*m*); the posterior margin is furnished with a series of strong and conspicuous spine-like teeth, and the dactylos is laterally compressed. The posterior pair is a little shorter than the preceding.

The pleopoda in the female have an elongated, flattened, longitudinally bent peduncle, supporting two long, foliaceous branches fringed with long hairs, and subequal in length in all excepting the first pair, which has the inner and anterior branch shorter for the purpose of supporting the ova, whereas in all the others it is free.

The sixth or terminal pair (*v*), which forms the lateral plates of the rhipidura, is strengthened down the median line of the outer branch as well as on the outer margin, and possesses a diæresis, the portion beyond which is narrower than that anterior to it.

Heterocarpus alphonsi, n. sp. (Pl. CXII. fig. 1).

Carapace furnished with five carinæ, of which the median is produced to a rostrum that is one and three-fourths longer than the carapace; it is armed dorsally with some large teeth, of which the posterior two stand near together upon the gastric region, and the most anterior a little distant from the apex of the rostrum; the under side is armed with eleven teeth, of which the anterior is subapical and the posterior in advance of the ophthalmopoda. The outer canthus of the orbit is armed with a strong tooth, which is not confluent with the upper lateral carina, and the infero-lateral angle is also armed with a short tooth, that is confluent with the lower lateral carina.

The first two somites of the pleon are smooth, but a distinct dorsal carina commences

abruptly at the anterior margin of the third somite, and is produced to a strong, sharp tooth at the posterior extremity of this and the two following somites. The sixth somite is smooth and the telson is dorsally flat, and armed at the lateral angles with three small spinules.

The ophthalmopoda are of moderate size and orbicular.

The first pair of antennæ has the flagella of unequal length; the shorter and more robust is subequal with the rostrum, and the longer and more slender is half as long again.

The second pair of antennæ is longer than the animal, and carries a scaphocerite which is nearly half the length of the rostrum.

The second pair of gnathopoda is slender, but does not reach to the extremity of the scaphocerite.

The first pair of pereiopoda is more slender, and nearly as long as the second pair of gnathopoda. The second pair of pereiopoda (figs. 1*l*, 1*l'*) has the appendage on the right side (fig. 1*l*) shorter and more robust than that on the left (fig. 1*l'*), and is long, slender, and minutely chelate. The three following pairs have the meros serrate posteriorly, the propodos fringed with short, stiff, hair-like spines, and the dactylos styliform.

The outer plates of the rhipidura are a little longer than the telson and furnished with a perfect diæresis, the outer angle of which is armed with small spines.

	Female.	Male.
Length, entire,	83 mm. (3·2 in.).	67 mm. (2·6 in.).
„ of carapace,	26 „	21 „
„ of rostrum,	34 „	26 „
„ of pleon,	57 „	46 „
„ of third somite of pleon,	14 „	12 „
„ of sixth somite of pleon,	12 „	10 „
„ of telson,	15 „	13 „

Habitat.—Station 214, February 10, 1875; lat. 4° 33′ N., long. 127° 6′ E.; south of the Philippines; depth, 500 fathoms; bottom, blue mud; bottom temperature, 41°·8. Fourteen specimens; eight males, five females, and one young. Trawled.

Station 232, May 12, 1875; lat. 35° 11′ N., long. 139° 28′ E.; *Hyalonema*-ground, off Japan; depth, 345 fathoms; bottom, green mud; bottom temperature, 41°·1. One specimen; male. Trawl and dredge both used.

Length, 37 mm.

This species is not very far separated from *Heterocarpus oryx*, A. Milne-Edwards,[1] but the teeth that form the dorsal armature commence over the gastric region, so that there are only two small teeth on the carapace posterior to the rostrum. There are only nine altogether on the upper surface and eleven on the lower, all of which

[1] *Ann. d. Sci. Nat.*, sér. 6, tom. xi., art. 4, p. 10, 1881.

are remarkably long and slender. The upper lateral carina commences near the posterior margin of the carapace, traverses the line between the dorsal and branchial regions, and ends anteriorly near the middle of the orbit. The first antennal tooth, situated at the outer canthus of the orbit, is long, sharp and not confluent with any of the carinæ. The second antennal tooth is long, straight, and is continuous with a carina or ridge that extends to the posterior margin.

The pleon has the first two somites smooth; the third is carinated, the ridge, which commences abruptly at the anterior margin, is longitudinally fluted and produced to a tooth posteriorly; the fourth and fifth somites are carinated and produced posteriorly to a tooth parallel with the dorsal surface. The sixth somite is smooth, dorsally slightly fluted longitudinally, as is also the telson, which is likewise laterally compressed; the longitudinal angle is armed with three small spines and the extremity is tipped with four.

The ophthalmopoda are short and orbicular.

The first pair of antennæ carries a stylocerite that reaches considerably beyond the extremity of the ophthalmopod, and terminates in two flagella of unequal size; the shorter and upper is the more robust, and extends a little beyond the extremity of the rostrum; the inner and lower is more slender, and is about half as long again as the upper. The second pair of antennæ is about once and a half the length of the animal, and carries a scaphocerite, that has the margins subparallel, and armed with a tooth on the outer margin that does not reach to the extremity.

The pereiopoda and other appendages offer no very decided features of specific character.

This species is represented by fourteen specimens, which were taken off the south-eastern extremity of the Philippine Islands, the largest being 83 mm. long, and one taken off the southern shores of Japan which is only 37 mm. long; it is, moreover, more slender generally, and has the rostrum relatively longer and armed with ten teeth on the upper margin and thirteen on the under.

The specific name is derived from the Christian name of Alphonse Milne-Edwards, who was the first to define the genus.

Heterocarpus gibbosus, n. sp. (Pl. CXII. fig. 2).

Carapace having five imperfect carinæ. Dorsal carina scarcely visible at the posterior margin, but elevated to a strong crest, armed with six large teeth over the gastric and frontal regions, and produced anteriorly to a long laterally compressed rostrum, directed obliquely upwards, and armed on the upper margin with three small equidistant teeth, and on the lower with eleven or twelve, which diminish in size anteriorly. The lateral carinæ are rather elevations than distinct ridges, and are lost before reaching the posterior margin.

The pleon is smooth. The third somite is slightly gibbous but not produced to a tooth.

The telson is laterally armed with four small spines on each side, and is subequal in length with the outer plates of the rhipidura.

Length, entire,	43 mm. (1·7 in.).
„ of carapace,	16 „
„ of rostrum,	20 „
„ of pleon,	27 „
„ of third somite of pleon,	8 „
„ sixth somite of pleon,	5 „
„ telson,	5 „

Habitat.—Station 207, January 16, 1875; lat. 12° 21′ N., long. 122° 15′ E.; off Tablas Island; depth, 700 fathoms; bottom, blue mud; bottom temperature, 51°·6. One specimen. Trawled.

This species may easily be distinguished from the others by the general smoothness of the carapace and pleon. There are only two lateral carinæ, but neither of them is very pronounced, only forming slight longitudinal elevations. The upper lateral carina commences just within the orbital margin, traverses the hepatic region, and then ascends in a curved line, approaching but not quite reaching the posterior margin; it coincides with the upper lateral carina in *Heterocarpus carinatus*. The carina, which in *Heterocarpus carinatus* is confluent with the tooth that stands on the frontal margin at the outer canthus of the orbit, is wanting, the elevation ending a little below the upper carina. The carina which commences at the second antennal tooth corresponds with the lower carina in *Heterocarpus carinatus;* in this species it is prominent anteriorly, but gradually loses its importance, and ceases before it reaches the posterior margin of the carapace. The dorsal carina is strongly elevated over the gastric region, where it is armed with six large subequal teeth; a seventh, not quite so large, stands on the rostrum anterior to the eyes, and two others, equally distant from each other and from the apex, stand on the upper margin of the rostrum, which is laterally compressed and obliquely elevated. The lower margin is armed with twelve teeth, all sharp and anteriorly directed, and gradually diminishing in size as they approach the apex.

The pleon is smooth and without any armature, but the third somite is elevated in the median line to a longitudinal ridge or tuberosity that gives it a gibbous appearance.

The telson (fig. 2z) is dorsally flattened and laterally compressed at the margins, and on each side the longitudinal angle formed by the lateral compression is armed with four small spines, and the extremity is fringed with four, of which the two outer are the larger.

The ophthalmopoda are orbicular, of moderate size, and projected upon a short and slender pedicle.

The first pair of antennæ carries a stylocerite that is sharp pointed and reaches beyond the extremity of the first joint, the flagella are both slender, and the longest is nearly as long again as the rostrum.

The second antennæ carries a scaphocerite that tapers but slightly distally, and the external tooth is subapical.

The pereiopoda are moderately strong; the meros in the three posterior pairs is sparsely armed with strong teeth on the posterior margin, and the dactylos is cylindrical.

The pleopoda increase in length posteriorly, and the outer branches of the last pair, which help to form the tail fan, are a little longer than the telson.

This species, which is represented by a single specimen, corresponds closely with the figure of *Heterocarpus lævis* given by A. Milne-Edwards, the chief distinction being that *Heterocarpus lævis* has a series of small teeth at the posterior extremity of the dorsal crest, and the flagella of the first pair of antennæ are much shorter, reaching, according to A. Milne-Edwards' figure, not beyond the extremity of the rostrum, whereas in *Heterocarpus gibbosus* they are unequal, one being a little longer than the rostrum, and the other about twice the length. In *Heterocarpus gibbosus* the third somite of the pleon is dorsally elevated into an elongated eminence, which gives the animal a more markedly sinuous appearance than in *Heterocarpus lævis.*

Heterocarpus lævigatus, n. sp. (Pl. CXII. fig. 3).

Pleon dorsally free from large teeth. Carapace furnished with a central and two lateral carinæ, the median armed with four teeth on the dorsal crest and one on the rostrum in advance of the orbit, anterior to which the rostrum is smooth and abruptly elevated obliquely, and armed with six teeth on the lower margin, of which the anterior is near the apex. The first lateral carina originates above and behind the outer orbital tooth, and passes back to just within the posterior margin of the carapace; the second carina commences in the fronto-lateral tooth and continues back for about two-thirds of the length of the carapace.

The first pair of antennæ has one flagellum as long as, and the other twice the length of, the rostrum. The second pair has the scaphocerite about half the length of the rostrum.

The third somite of the pleon is furnished with a dorsal longitudiual tubercle, and the telson is armed with four lateral and several terminal spines.

Length, entire,	55 mm. (2·1 in.).
„ of carapace,	20 „
„ of rostrum,	20 „
„ of pleon,	35 „
„ of third somite of pleon,	8 „
„ of sixth somite of pleon,	6 „
„ of telson,	12 „

Habitat.—Station 194, September 29, 1874; lat. 4° 34′ 0″ S., long. 129° 57′ 30″ E.; off Banda Island; depth, 200 fathoms; bottom, volcanic mud. One specimen, male, associated with two female specimens of *Heterocarpus dorsalis*. Dredged.

This species in many ways resembles *Heterocarpus lævis*, A. Milne-Edwards, but differs in several more or less important points from the figure given by him in the drawings of the Crustacea of the Blake[1] Expedition.

The carapace is dorsally compressed to a carina in the median line, which is armed with four large teeth, of which the posterior stands over the cardiac region and the anterior over the orbital, besides which there is a small tooth on the upper surface of the rostrum a little in advance of the ophthalmopoda. The rest of the rostrum is smooth to the extremity, the apex of which is broken off in our solitary specimen; it is bent somewhat abruptly and obliquely upwards. The lower surface is armed with six teeth, of which the anterior is not far from the apex and small, while the rest are larger. The upper lateral carina commences above and behind the tooth at the outer canthus of the orbit, and continues to within a short distance of the posterior margin of the carapace, where it abruptly turns towards the dorsal median line and is quite or nearly lost in the surrounding tissue; the lower or second lateral carina commences in a large and well-developed tooth at the fronto-lateral angle of the carapace, and passes longitudinally backwards to about three-fourths the length of the carapace, where it is lost in the surrounding tissue.

The anterior two somites of the pleon are dorsally rounded and smooth; the third is laterally compressed and dorsally elevated in the median line into an elongated tuberosity, which is smooth on the surface and lost at the anterior and posterior margins of the somite. The fourth somite is also laterally compressed and shows indications of a dorsal longitudinal tuberosity; the fifth somite is dorsally rounded and laterally compressed. The sixth is laterally compressed and dorsally flattened; the posterior margin is furnished with a tooth on each side above the articulation of the posterior pair of pleopoda, and projects directly backwards, forming a right angle on the upper side and a waved line on the lower.

The telson is dorsally flattened and anteriorly channelled; the sides are depressed and the angle formed by the depression is armed with four small spines; the extremity is formed by a small central rigid tooth with two movable spines on each side, of which the outer is the longer, and has at its base on the outer side another small spine. The ophthalmopoda are short and pyriform, and the ophthalmi are globular and brown in colour.

The first pair of antennæ has the first joint of the peduncle deeply excavate to receive the ophthalmopod, and is furnished on the outer margin with a long and slender stylocerite that reaches anteriorly as far as the distal extremity of the third joint of the

[1] Recueil de Figures de Crustacés nouveaux ou peu connus.—1ere Livraison (comprenant 44 planches). Avril, 1883.

peduncle. At the base of the stylocerite on the outer margin is a smaller process, that is slightly curved upwards and forwards and appears to assist in protecting the ophthalmopod when at rest. The second and third joints are short and cylindrical, and support two slender flagella, of which the outer is the more robust and the inner the longer, equalling half the length of the animal.

The second pair of antennæ has attached to the first or coxal joint a well-developed phymacerite. The second joint supports a scaphocerite that is about half the length of the rostrum; the inner and outer margins are subparallel, and the distal extremity of the inner plate does not project anteriorly beyond the extremity of the outer distal tooth; the terminal two joints of the peduncle are subequal in length and distally support a flagellum that is longer than the animal.

The oral appendages have not been examined, but they are probably only of generic value. The second pair of gnathopoda is tolerably robust and has the terminal and penultimate joints subequal, whereas the antepenultimate is somewhat longer.

The first pair of pereiopoda is about the same length as the preceding pair of gnathopoda but more slender, and has the terminal joint shorter than the penultimate. The second pair has the right appendage wanting, but the left has the carpos long and about equal in length to the rest of the pereiopod. The posterior three pairs are more slender than in most species, and the teeth on the meros are smaller and less important.

The first pair of pleopoda is unequally branched. In the solitary specimen, which is a male, the inner and smaller branch is furnished near the distal extremity with a small rudimentary stylamblys; the second pair has the branches subequal and the inner and posterior carries a long stylamblys, as it also does in the third pair, while the fourth has one of smaller proportion and the fifth has none at all. The inner branches are more slender and feeble than the outer.

Heterocarpus ensifer, A. Milne-Edwards (Pl. CXII. fig. 4).

Heterocarpus ensifer, A. Milne-Edwards, Ann. d. Sci. Nat., sér. 6, tom. xi., art. 4, p. 8, 1881; Recueil d. Fig. Crust., 1883.

Pandalus carinatus, Sidney Smith, Bull. Mus. Comp. Zoöl., vol. x. p. 63, pl. x. figs. 2–2*f*., pl. xi. figs. 1–3, 1882.

Carapace having seven carinæ; the central or dorsal is elevated into a crest, continuous with the rostrum, which equals the length of the carapace. It is armed on the upper surface with seventeen teeth, the posterior of which corresponds with the pyloric region and they continue nearly to the apex of the rostrum; the lower margin is armed with twelve teeth, of which the posterior are the larger.

The upper lateral carina extends from the gastric region to the posterior margin of the carapace; the median lateral carina passes from the tooth at the external canthus of the orbit, with which it is confluent, to the posterior margin of the carapace; the

lower lateral commences in the second antennal tooth and continues to the posterior margin of the carapace.

The first two somites of the pleon have a small carina in the median line; the third is strongly carinated and produced to a large, laterally compressed tooth; the fourth is slightly carinated and produced posteriorly to a strong tooth. The fifth and sixth somites are smooth, and the telson is armed with four little spines on the dorso-lateral angle.

Length, entire,	64 mm. (2·5 in.).
,, of carapace,	21 ,,
,, of rostrum,	23 ,,
,, of pleon,	43 ,,
,, of third somite of pleon,	14 ,,
,, of sixth somite of pleon,	7 ,,
,, of telson,	12 ,,

Habitat.—Station 200, October 23, 1874; lat. 6° 47′ N., long. 122° 28′ E.; between the Philippine Islands and Borneo; depth, 250 fathoms; bottom, green mud. Two specimens; males. Trawled.

West Indies ("Blake" Expedition).

These specimens so closely resemble *Heterocarpus ensifer*, A. Milne-Edwards, and *Pandalus carinatus*, Smith, that I do not hesitate to consider it the same species; any differences probably depend on the condensed description given by the authors. A. Milne-Edwards describes it as having a median dorsal carina projecting anteriorly to a rostrum that is laterally compressed, slightly elevated anteriorly, and armed on the upper side with seventeen teeth and on the lower with eight, which corresponds with the armature of the present specimens, and as being furnished with a third carina, which is above the other two lateral ones and much less prominent. In the Challenger specimens this carina, the upper of the three lateral, is very distinct from the hepatic region to the posterior margin, but wanting in front of the hepatic region, although in certain lights a ridge is visible, which terminates anteriorly near the middle of the orbital margin.

There is a low, thick carina on the median dorsal line of the first two somites of the pleon; on each side of the first somite there is a small tubercle and the trace of a second, and below it an elevated line, corresponding with the continuation of a carina on the carapace. The third somite is laterally compressed and strongly carinated, the carina commencing abruptly at the anterior margin and being produced posteriorly to a large, strong tooth; on the fourth somite the carina is but little marked at the anterior margin, but gradually rises, and is produced posteriorly to a long, narrowly compressed tooth, not quite so large as that on the preceding somite. The fifth and sixth somites are smooth, laterally compressed, and destitute of either carina or tooth.

The telson is as long as the lateral plates of the rhipidura; it is dorsally flattened and laterally compressed, the longitudinal angles being armed with four small spines on each side, and terminates in two long outer and two small inner spines.

The ophthalmopoda are short, thick and orbicular.

The first pair of antennæ has the peduncle short, the first joint being furnished with a short, sharp pointed stylocerite. The flagella are scarcely longer than the rostrum.

The second pair of antennæ carries a long, narrow scaphocerite, which tapers to the distal extremity and is armed with an external apical tooth, and bears a flagellum as long as the body of the animal. The appendages are slender, tolerably robust, and not of extreme length.

The pleopoda are short and strong, and the posterior pair, which helps to form the rhipidura, is not longer than the telson; the outer plate is longitudinally grooved, and furnished with a perfect diæresis, the outer limit of which is defined by a small spine.

Observations.—The close resemblance of the specimens taken by the Challenger in the Oriental Archipelago to those found at the West Indies, and, therefore, on the opposite side of the globe, is a matter of interest, since this species has not yet been found at any intermediate locality, and does not inhabit depths greater than about 500 fathoms.

Plesionika, n. gen.

Carapace smooth; dorsally carinated anteriorly, and produced to a long, narrow, laterally compressed rostrum, which as well as the frontal crest is armed with teeth.

Ophthalmopoda biarticulate.

First pair of antennæ armed with a sharp point and a wide stylocerite, and terminating in two long slender flagella.

Second pair of antennæ terminates in a long and slender flagellum, and carries a long, narrow scaphocerite, that is armed on the outer side with a strong subapical tooth.

Mandible having a three-jointed synaphipod; psalistoma well developed and distinct from the molar tubercle.

Second pair of gnathopoda pediform, and destitute of a basecphysis.

First pair of pereiopoda slender and simple, terminating in a small styliform dactylos. Second pair long, slender, and minutely chelate, the carpos being long, flexible and multi-articulate. Three following pairs long, slender, and simple, remarkable for the great length of the carpal and propodal joints.

Pleon about three times as long as the carapace, and terminating in a long, narrow and tapering telson, the sides of which are depressed. Pleopoda long, carrying flat sub-foliaceous rami; outer plates of the rhipidura subequal with the telson.

The branchiæ are well developed and differ from those of *Pandalus* in having a

pleurobranchial plume attached to the somite that supports the second pair of gnathopoda, as shown in the annexed table :—

Pleurobranchiæ,	...	1	1	1	1	1	1
Arthrobranchiæ,	...	1	1	1	1	1	...
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	1	r	r	r	r	r	...
	h	i	k	l	m	n	o

Observations.—This genus is closely allied to *Pandalus*, but is distinguishable from it by having the frontal crest and rostrum armed with fixed teeth instead of movable spines, the flagella of the first pair of antennæ very long and slender, the stylocerite sharply pointed instead of being rounded and disc-like, and the posterior extremity of the mastigobranchial plate of the second pair of siagnopoda rounded off, short and abrupt, instead of being produced to a long lash as it is in *Pandalus*. It differs also in having a pair of branchial plumes connected with the second pair of gnathopoda. From *Pandalopsis* it differs in a less degree, and that is in the existence of teeth instead of spines on the dorsal crest, and in the presence of small or rudimentary mastigobranchial appendages attached to all the pereiopoda excepting the posterior pair, whereas in *Pandalus* they are absent from the four posterior pairs.

These three forms have been associated by authors in the single genus *Pandalus*, but I think the variation in their external structure is sufficiently important to warrant their separation into distinct genera.

Plesionika uniproducta, n. sp. (Pl. CXIII. fig. 1).

Carapace smooth, carinated anteriorly in front of the cardiac region. Rostrum as long as the carapace, dorsal surface at the base crested and armed with seven closely crowded teeth in the male, and with five in the female; upper margin of the rostrum smooth to the apex, under margin armed with sharp anteriorly directed teeth, extending from the base to the extremity.

Pleon smooth, laterally compressed. In the female the posterior margin of the third somite is produced to a sharp point in the median line; in the male only a trace of this feature exists.

Telson not so long as the lateral plates of the rhipidura, laterally compressed, dorsally flat, armed on each side at the dorso-lateral angles with three small spines and two or three terminal spine-like hairs.

Length, entire (male),	94 mm. (3·7 in.).
„ of carapace,	24 „
„ of rostrum,	31 „
„ of pleon,	70 „
„ of third somite of pleon,	10 „
„ of sixth somite of pleon,	15 „
„ of telson,	15 „

Habitat.—Station 122, September 10, 1873; lat. 9° 5′ S., long. 34° 50′ W.; off Barra Grande; depth, 350 fathoms; bottom, red mud. Two specimens; one male, one female. Trawled.

The rostrum is compressed laterally, depressed slightly from the level of the dorsal surface to beyond the reach of the eye, and then gradually rising in a straight line; it is smooth on the upper side from the apex to the base, where, on a line with the extremity of the third joint of the first pair of antennæ, there stands one small tooth, and at a little distance behind a row of teeth that gradually decrease in size posteriorly. In the male there are seven, in the female only five such teeth; but there is only one specimen of each for comparison. The surface of the carapace is smooth and polished; the anterior margin is produced to a small tooth at the antennal angle, and another at the fronto-lateral angle.

The pleon is smooth and laterally compressed, especially behind the third somite, which is produced posteriorly in the median line, to a slight extent in the male, but forming a sharp point in the female, the point, when the pleon is extended, lying in close proximity to the surface of the next succeeding somite.

The ophthalmopoda (fig. 1*a*, *a*) are orbicular, and stand upon extremely short and slender pedicles, attached to the ophthalmic somite, which is free and external to the carapace; it lies across the frontal surface, and is produced in the median line to a strong pointed cusp or tooth.

The first pair of antennæ (fig. 1*b*) has the first joint broad, deeply hollowed and furnished on the outer side with a broad, flattened, and pointed stylocerite, which follows the contour of the deep excavation in which the eye rests; the anterior margin of the joint is fringed with a row of posteriorly directed cilia. The second and third joints are short, and terminate in two flagella, the outer of which is the broader; it is compressed for a considerable distance, and then suddenly narrows, becoming slender and cylindrical. The two flagella are subequal, and about twice the length of the rostrum.

The second pair of antennæ (fig. 1*c*) is armed with a sharp spine-like tooth on the under side of the outer distal margin of the second joint, near the base of the scaphocerite, which is long, narrow, and rather more than half the length of the rostrum; the distal extremity is narrower than the base, and has on the outer margin a small subapical tooth passing beyond the apex; within the margin the upper surface is traversed by a longitudinal groove. The flagellum of this antenna is broken off in both specimens, but I judge it to be a little longer than those of the first pair.

The anterior labrum orepistom a (fig. 1, *ant.*) is transversely ridged and longitudinally short, and is produced anteriorly to a long projecting tooth in the median line. The metastoma (fig. 1, *post.*) is transversely wider and shorter; between these two the mandibles articulate on each side.

The mandible (fig. 1*d*) consists of a broad apophysis supporting a long, narrow, subcylindrical, molar process, a distinct narrow, flattened, and slightly curved psalistoma, and a triarticulate synaphipod.

The first pair of siagnopoda (fig. 1*e*) is three-branched, the central branch being broad and disc-like.

The second pair (fig. 1*f*) is two-branched, the inner branch being bilobed, and each lobe fringed with short spicules; the second branch is short and tapering, and on the outer side, attached to the coxal joints, is a mastigobranchial plate produced as a broad foliaceous plate, anteriorly beyond the extremity of the inner branches, and posteriorly but little beyond the coxal joint, and fringed with hairs directed centrifugally to the front.

The third pair of siagnopoda (fig. 1*g*) is three-branched, and carries a mastigobranchia of two plates; the inner branch is broad and fringed with hair on the inner margin, the second is slender, cylindrical, and tipped with hairs, the third consists of a broad foliaceous plate, from the inner margin of which springs a long and slender flagellum fringed with small hairs, and on the outer margin attached to the coxal joint are two membranous plates springing from a common base, the one anteriorly, the other posteriorly.

The first pair of gnathopoda (fig. 1*h*) is six-jointed and subpediform; the coxal joint carries a mastigobranchial plate and an arthrobranchial plume; the basis supports a long ecphysis, and the two succeeding joints are subcylindrical and subequal in length, the two terminal being reflexed against the preceding, and fringed on the inner margin with closely packed hairs.

The second pair of gnathopoda is long, slender, and pediform, terminating in a long and tapering propodal joint, the dactylos being absent, and carries an ecphysis or branch attached to the basisal joint.

The pereiopoda are all slender, but not remarkably long; the carpos is about half the length of the meros, the posterior distal portion of which is dentated with spine-like points, and about the same length as the propodos, which terminates in a short and slightly curved dactylos.

The pleopoda are moderately long, except the first pair, which is short, one branch being much shorter than the other. The rest have the rami long, narrow, and subfoliaceous; in both sexes the posterior and inner branch carries a stylamblys that has the distal extremity oblique and armed with numerous cincinnuli. The posterior or sixth pair forms the lateral plates of the rhipidura; these are longer than the telson, and the outer plate carries a well-defined diæresis.

Observations.—The two specimens, a male and a female, belong, I think, to the same species; but had they been taken at separate stations, the variations between them might have appeared sufficient to justify their separation as distinct species. These are, the

different number of the teeth on the rostral crest, and the produced point on the third somite in the female, from which the specific name is derived, being so much reduced in the male.

This species bears some resemblance to *Pandalus martius*, A. Milne-Edwards, obtained during the expedition of the "Travailleur,"[1] from which it chiefly differs in having the rostrum not quite so long, and the serrature of the lower margin stronger, in the presence of the pointed or tooth-like process at the posterior dorsal margin of the third somite of the pleon, and in having the dactylos shorter in the three posterior pereiopoda.

Plesionika semilævis, n. sp. (Pl. CXIII. fig. 3).

Carapace smooth, rostrum once and half as long as the dorsal surface of the carapace, smooth on the upper surface, minutely serrate on the lower, frontal crest armed with six teeth.

Pleon smooth and laterally compressed.

Telson dorsally flat and laterally compressed.

Ophthalmopoda large, reniform.

First pair of antennæ having the flagella as long again as the rostrum.

Second pair having the flagellum subequal with those of the first pair; scaphocerite about half the length of the rostrum.

Pereiopoda long, but not extremely so.

Pleon smooth and polished.

Telson shorter than the outer plates of the rhipidura and equal with the inner.

	Female.	Male.
Length, entire,	74 mm.	74 mm. (2·9 in.).
„ of carapace,	19 „	20 „
„ of rostrum,	32 „	34 „
„ of pleon,	55 „	54 „
„ of third somite,	10 „	10 „
„ of sixth somite,	13 „	13 „
„ of telson,	13 „	14 „

Habitat.—Station 200, October 23, 1874; lat. 6° 47′ N., long. 122° 28′ E.; between the Philippine Islands and Borneo; depth, 250 fathoms; bottom, green mud. Sixteen specimens; nine males and seven females, five laden with ova. Trawled.

Station 164A, June 13, 1874; lat. 34° 9′ S., long. 151° 55′ W.; off Sydney Harbour, Australia; depth, 1200 fathoms; bottom, green mud. Two damaged specimens. Associated with *Nothocaris rostricrescentis*.

Station 170, July 14, 1874; lat. 29° 55′ 9″ S., long. 176° 14′ W.; off the Kermadec

[1] Recueil de Figures de Crustacés nouveaux ou peu connus, 1883.

Islands; depth, 520 fathoms; bottom, volcanic mud; bottom temperature, 43°. Six specimens; five males and one female. Trawled.

Station 173, July 24, 1874; lat. 19° 9′ 35″ S., long. 179° 41′ 50″ E.; off Matuka, Fiji Islands; depth, 315 fathoms; bottom, coral mud. Seven specimens; three males and four females, two of which are young. Dredged.

Observations.—The general appearance of the specimens trawled near the Philippine Islands is not very different from that of *Plesionika uniproducta*, from off the Atlantic coast of South America, but they differ in having the teeth on the rostral crest more regularly disposed and constant in number; in both sexes there are six teeth, whereas in *Plesionika uniproducta* the male has seven and the female only five, and the anterior tooth is separated by a space from the rest, while in *Plesionika semilævis* the teeth are disposed at regular but gradually decreasing intervals from the first to the last, as they gradually diminish in size posteriorly. In this species also the third somite is not posteriorly produced in the median line to a point; and the ophthalmopoda are larger and the ophthalmi more reniform than orbicular. In most other points the two species correspond; in both the rostrum anterior to the eyes is depressed and then directed horizontally forwards in a straight line, the upper margin being smooth and the lower serrate, with sharp, evenly planted and anteriorly directed teeth, which appear to be a little finer in *Plesionika semilævis* than in *Plesionika uniproducta*. In both, also, the meros in the three posterior pairs of pereiopoda is armed with small and sharp teeth. They were both taken from corresponding depths and from muddy bottoms.

The specimens taken near the Kermadec Islands are generally more slender, the legs rather longer and the rostrum longer and more rigidly straight, and some of the specimens have the rostral crest adorned with eight teeth, and the ocellus, although clearly defined, is not separated from the dark pigment of the ophthalmus. The length is from three to four inches, and the second antennæ is nearly as long again as the animal.

Comparing the specimens of this species from the different localities with *Pandalus martius*, A. Milne-Edwards, taken at from 400 to 1200 fathoms in the Atlantic, the differences are very slight. According to Milne-Edwards' figure the rostrum and the dactylos of the posterior three pairs of pereiopoda are relatively longer, and the ophthalmopoda are not quite so large, and more orbicular.

A damaged specimen taken at Station 192 appears to belong to this species. It has been attacked by two species of parasitic Isopods; one, resembling *Phryxus hindmanni*, was found underlying the carapace, and almost filled the branchial chamber, but without doing much damage to it; the male was also present, hugging close round the telson of the female. The male of this species had not been determined at the time of publication of the British Sessile-Eyed Crustacea.

The other parasite found on the same animal closely approximates to *Phryxus*

abdominalis, Kröyer, but differs in having the branchial plates of the female pointed at the extremity, instead of being rounded as in the typical specimens.

Both specimens were gravid with an enormous number of ova.

Plesionika spinipes (Pl. CXIII. fig. 2).

Carapace smooth; rostrum about twice the length of the carapace, serrate on the upper and lower margins.

Pleon smooth.

Telson slender; armed with two or four spines at the terminal extremity and three small ones on the dorso-lateral surface.

Pereiopoda slender and longer than the body of the animal, the three posterior pairs extending beyond the extremity, and having the meros posteriorly armed with spines.

The scaphocerite about half the length of the rostrum.

Length, entire (male),	43 mm. (1·7 in.).
„ of carapace,	12 „
„ of rostrum,	25 „
„ of pleon,	31 „
„ of third somite of pleon,	5 „
„ of sixth somite of pleon,	6 „
„ of telson,	7 „

Habitat.—Station 219, March 10, 1875; lat. 1° 54′ 0″ S., long. 146° 39′ 40″ E.; north of New Guinea; depth, 150 fathoms; bottom, coral mud. Eight specimens; seven males, one female. Trawled.

This species has the rostrum very straight, and finely and evenly serrate on the upper and lower margins with small closely packed teeth that have their apices directed forwards. The serrature on the upper surface commences on the anterior portion of the gastric region, that on the under margin begins a little in advance of the eye. The rest of the surface of the carapace is smooth. Two small teeth, one corresponding with the first pair of antennæ, the other with the fronto-lateral angles, stand on the frontal margin. The pleon is smooth and free from markings of any kind; the third somite is slightly arcuate. The telson is narrow and laterally compressed, the dorso-lateral angle being furnished with three small spinules, seen best in a lateral aspect, and there are two or three longer ones at the extremity.

The ophthalmopoda are of moderate size and stand on short pedicles.

The first pair of antennæ has the first joint deeply excavated to receive the ophthalmopod, and is furnished on the outer side with a sharp stylocerite; the second and third joints are short, and terminate in two unequally long flagella, the shorter of which passes

considerably beyond the rostrum, which is more than half the length of the animal. Both flagella are slender, but the outer is more robust towards the base.

The second pair of antennæ has the second or basisal joint armed on the outer and under side with a small sharp tooth, and carries a scaphocerite that has nearly parallel sides, the outer being rigid and terminating in a small distal tooth that reaches to about half the length of the rostrum. The third joint terminates in a flagellum that reaches a little beyond the longest flagellum of the first pair.

The second pair of gnathopoda is long, slender, and pediform, the second joint or basis is furnished with a slender branch, the third or ischium is short, the fourth or meros is extremely long and slender, as is also the fifth joint or carpos, and the sixth or propodos is about half the length of the carpos, and terminates in a flattened point, the margins of which are notched for the reception of hairs or spines.

The first pair of pereiopoda is more slender and longer than the second pair of gnathopoda, having the meros and propodos about half the length of the carpos and terminating in a rudimentary dactylos (fig. 2*k*). The second pair of pereiopoda is unequal, that on the right side being shorter and more slender; the carpos is long and multiarticulate, the propodos scarcely longer or broader than the ultimate articulus of the carpos; the pollex and dactylos are small and form a perfect but minute chela. The three posterior pairs are very long, reaching forwards very considerably beyond the extremity of the rostrum; the meros is long, and furnished on the posterior or lower margin with a series of slender, sharp, spine-like teeth, from which the name of the species is derived; the carpos is very long and more slender than the meros, as is also the propodos, while the dactylos is short and styliform. The rest of the animal offers no peculiar feature of specific interest, except that the posterior pair of pleopoda, which forms the tail-fan, is longer than the telson.

The branchiæ in this species deviate from the typical arrangement of the genus in having no mastigobranchial appendage attached to the several pairs of pereiopoda; they may be tabulated as follows:—

Pleurobranchiæ,	...	1	1	1	1	1	1
Arthrobranchiæ,	...	1	1	1	1	1	...
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	1	...	...	...	...	...	...
	h	i	k	l	m	n	o

Observations.—All the specimens in the collection, except one, appear to be males, and bear a close comparison with *Pandalus stylopus*, A. Milne-Edwards, which was taken in the Atlantic during the expedition of the "Travailleur," at a depth of 530 fathoms. It differs, however, in several points of more or less importance. The first pair of antennæ, for instance, has the flagella much longer, being twice the length of the rostrum; the serrature of the rostrum is more alike on the two margins; the second pair of pereiopoda

is unequal on the two sides, both in length and proportion; and the propodos of the three posterior pairs of pereiopoda is more nearly equal in length to the carpos.

This species still more closely resembles *Pandalus longipes*, A. Milne-Edwards, but in the latter the first pair of antennæ and the rostrum are longer. It also appears to be nearly allied to *Pandalus narwal* (Fabricius), as described by Herbst, Latreille, Milne-Edwards and Heller, which was taken in the Mediterranean.

The Challenger species differs externally from either in having the serrature on the dorsal crest more slender, closely packed, and extending posteriorly to the pyloric region. *Pandalus stylopus*, *Pandalus longipes* and *Pandalus narwal*, all of which appear to me to belong to this genus, have the teeth on the crest and base of the rostrum coarse, whereas those on the distal portion of the rostrum are fine in *Plesionika spinipes*.

Plesionika unidens, n. sp. (Pl. CXIII. fig. 4).

Rostrum twice the length of the carapace, crested and armed with teeth at the base; smooth on the upper surface to the apex, except for the presence of one tooth a little posterior to the distal extremity; the lower margin is furnished with six or seven teeth.

First pair of antennæ short, scarcely reaching beyond the extremity of the rostrum.

Second pair having the flagellum but little longer.

Pereiopoda slender but not remarkably long.

Third somite of the pleon dorsally compressed to a straight carina posteriorly.

Telson nearly as long as the outer rami of the rhipidura.

Length, entire (male),	40	mm. (1·5 in.).
„ of carapace,	11	„
„ of rostrum,	22	„
„ of pleon,	29	„
„ of third somite of pleon,	6	„
„ of sixth somite of pleon,	6	„
„ of telson,	7	„
Breadth of ophthalmus,	3·5	„

Habitat.—Station 219, March 10, 1875; lat. 1° 54′ 0″ S., long. 146° 39′ 40″ E.; north of New Guinea; depth, 150 fathoms; bottom, coral mud. Four specimens; two males and two (?) females. Trawled.

This species has the rostrum very long and straight. It may readily be distinguished from others by its having a solitary tooth on the upper margin of the rostrum, a little posterior to the apex, the rest is smooth and straight until near the base, where there are several teeth; those just in front of the eye are the largest; those behind the frontal margin are the smallest and most closely compressed together, they are all laterally compressed and stand like a crest above the eyes. From this crest a carina without

teeth extends to the posterior limit of the gastric region; the rest of the carapace is smooth, with a polished surface. The anterior or frontal margin carries a long antennal tooth, and the rudiment of one at the fronto-lateral angle.

The pleon is smooth and free from armature; it is laterally compressed, especially behind the third somite. In the third the compression is dorsally increased, so as to produce a small carina, that disappears both at the anterior and posterior extremities of the somite. The telson is laterally compressed, armed at the dorso-lateral angles with three small spines, and terminates in a few small hairs.

The ophthalmus is large and reniform, black in colour, and stands upon a short ophthalmopod.

The first pair of antennæ has the first joint short and deeply excavated for the reception of the ophthalmopoda; the two succeeding joints are short and hairy, and the two flagella do not reach beyond the extremity of the rostrum. The second pair carries a long, narrow scaphocerite, and a flagellum that scarcely reaches beyond the distal extremity of the rostrum.

The second pair of gnathopoda is robust, and reaches to half the length of the rostrum, the terminal joint being fringed with short, spine-like hairs.

The first pair of pereiopoda is nearly as long as the gnathopoda, but more slender. The second pair is minutely chelate, with a long multiarticulate carpos. The three following pairs are subequal, the posterior being the shortest and the anterior the longest, and have the lower or posterior margin of the meros sparsely dentate with small spine-like points. The carpos is smooth, about one-third the length of the meros, and is produced anteriorly to a small tooth on the propodal articulation; the propodos is smooth, and nearly, but not quite, as long again as the carpos; the dactylos is long, slightly curved, and sharply pointed.

The outer plate of the rhipidura has a diæresis armed with a small tooth on the outer margin; the inner plate is narrow and rounded terminally; it is fringed with long hairs, as is also the inner margin of the outer plate, and both are a little longer than the telson.

Observations.—The specimens of this species were taken at the same station as *Plesionika spinipes*, to which they bear a general resemblance, although they differ in the relative lengths of the pereiopoda, rostrum, and antennæ, and have proportionately larger eyes, and a differently formed rostrum. The meral joints of the three posterior pairs of pereiopoda resemble one another in the two species in having numerous little teeth along the posterior margin.

The branchiæ are arranged according to the typical condition in the genus; attached to the coxa of each pereiopod there is a small, almost rudimentary, mastigobranchial appendage, so diminished in size as to be apparently only a useless appendage.

Among the specimens appear to be two females, but of one I am uncertain.

Plesionika brevirostris, n. sp. (Pl. CXIII. fig. 5).

Rostrum a little shorter than the dorsal length of the carapace; free from spines on lower margin and on the upper anterior to the crest, which consists of six teeth. The rest of the carapace and pleon is smooth.

First pair of antennæ having the flagella as long as the animal.

Second pair having the flagellum a little longer than those of the first; scaphocerite subequal with the rostrum.

Second pair of gnathopoda reaching a little beyond the distal extremity of the rostrum.

Pereiopoda long and slender; first pair a little longer than the second pair of gnathopoda, but more slender. Second pair of pereiopoda a little shorter than the first and more robust; the carpos long and multiarticulate. Third, fourth, and fifth pairs increasing in length posteriorly, the last reaching beyond the extremity of the rostrum to a distance equal to the length of the carapace.

Telson dorsally depressed in the median line, shorter than the lateral plates of the rhipidura.

Length, entire,	97 mm. (3·8 in.).
„ of carapace,	26 „
„ of rostrum,	23 „
„ of pleon,	71 „
„ third somite of pleon,	13 „
„ sixth somite of pleon,	14 „
„ telson,	16 „

Habitat.—Station 200, October 23, 1874; lat. 6° 47′ N., long. 122° 28′ E.; between the Philippine Islands and Borneo; depth, 250 fathoms; bottom, green mud. One specimen, female. Trawled.

Observations.—The specimen was laden with numerous ova, of which I approximately counted 6000; it was trawled with considerable numbers of *Plesionika semilævis*, with which it appears to closely correspond in general aspect and in all parts, excepting in the shortness of the rostrum and the absence of teeth from the lower margin. It is not improbable that it is only an extreme variation in form of the latter species due to some accidental cause, and illustrating the early stage of a specific variation.

Nothocaris,[1] n. gen.

Carapace smooth; dorsally crested over the gastric region and produced to a long rostrum; armed on the crest with rigid teeth and movable spines; frontal margin having an antennal and fronto-lateral tooth.

[1] νόθος, illegitimate; καρίς, shrimp.

Pleon smooth; third somite dorsally arcuate, sixth short, having the lateral margins anteriorly confluent with the ventral surface.

Telson long, narrow, tapering, laterally compressed and dorsally flattened, and subequal in length with the outer plates of the rhipidura.

Ophthalmopoda biarticulate, standing at the extremities of a distinct somite. Ophthalmus large, pear-shaped, projecting laterally, the posterior portion being furnished with a large and well-formed ocellus, which, although close to, appears to be distinct from the true ophthalmus, and as thickly facetted as the primary organ.

First pair of antennæ having the peduncle short, supporting two long, slender flagella that are as long as the rostrum; first joint excavate on the upper surface and armed on the outer side with a sharp pointed stylocerite.

Second pair of antennæ carrying a long, narrow scaphocerite, armed on the outer side with a small tooth, and a long and slender flagellum about the length of the animal.

Mandibles furnished with a psalistoma and a three-jointed synaphipod.

First pair of gnathopoda having the distal joints reflexed; the basis armed with a long ecphysis, and the coxa with a small mastigobranchial plate and a small podobranchial plume.

Second pair of gnathopoda long and pediform; the basis carries a well-developed ecphysis and the coxa a rudimentary mastigobranchia, but no podobranchial plume.

First pair of pereiopoda slender and simple. Second pair long, slender and unequal, the left being longer and more feeble than the right, and minutely chelate; carpos multiarticulate; coxa supporting a rudimentary mastigobranchia, but no podobranchial plume. Three posterior pairs of pereiopoda subequal, moderately robust, and terminating in a small dactylos; coxa of third and fourth pairs supporting a rudimentary mastigobranchia, but the fifth has none.

Pleopoda biramose and semifoliaceous. Outer branch of the rhipidura furnished with a well-defined diæresis.

Telson laterally compressed and subequal with the caudal plates.

This genus is closely related to *Plesionika*, and, therefore, to *Pandalus*. In its external features it is most easily determined by the character of the armature of the dorsal crest, which consists of several spines that articulate in sockets, and several teeth that are fixed and rigid, being part of the dermal wall. It forms a link between *Heterocarpus*, A. Milne-Edwards, in which the armature of the crest consists entirely of fixed teeth, and *Pandalus*, in which they are all spines. Another feature which is strongly characteristic of this genus is the very perfect ocellus or secondary eye situated on the posterior surface of the ophthalmopod, which, when the eye is lying at rest in the excavation formed in the upper surface of the first joint of the first pair of antennæ, is vertically exposed.

In *Pandalus annulicornis* the ocellus also exists, but it is not exposed beyond the margin of the pigment that distinguishes the ophthalmus, but in *Nothocaris* it forms

a well-defined circular spot, or little eye, distinct from the primary organ. In *Plesionika*, *Pandalopsis* and *Pandalus* it is not conspicuous, but a process of the pigment extends beyond the margin as if it were an incipient condition of the more complete ocellus found in this genus.

In this genus, as distinguishing it from *Pandalus*, the stylocerite is sharp pointed and the flagella of the first pair of antennæ are long and slender, being as long as or longer than the rostrum or the carapace.

The mandibles are formed much like those in the genus *Heterocarpus*, in having the molar process cylindrical, and projecting at right angles to the apophysis; at the angle so formed the psalistoma and the three-jointed synaphipod projects.

The oral appendages resemble generically those of *Heterocarpus*, but in *Pandalus* the mastigobranchial plate of the second siagnopod extends backwards into the branchial chamber, and by means of the long terminal hairs at its distal extremity brushes all the plumes, whereas in *Nothocaris*, as in *Plesionika*, it terminates abruptly in a rounded extremity fringed with fine cilia, and does not extend into the branchial chamber.

The first pair of gnathopoda has the propodos long, broad, and reflexed against the meros, and the dactylos broad and continuous with the propodos.

The second pair of gnathopoda is five-jointed and pediform; the first joint or coxa carries a rudimentary mastigobranchia, at the base of which a flattened calcified disc projects at right angles; the basis is short and carries an ecphysis that is long, narrow, and about half the length of the ischium or succeeding joint; the ischium is long and has the margins parallel and fringed with tufts of hairs. The next joint is shorter, being not quite half the length of the preceding, and the terminal is longer but not quite so long as the ischium; it is cylindrical, and furnished at the extremity with two or three strong spines, and along the outer margin with a series of tufts of hairs, mingled with a few spines.

The first pair of pereiopoda is long, slender and pediform; the coxa carries a small mastigobranchia, and is furnished with a tuft of long hairs on a prominent tubercle; the basis is short and carries no ecphysis; the ischium is long, but not so long as the meros, with which it is connected by an oblique articulation, and it becomes slightly narrower towards the distal extremity, where it articulates with a long carpos; the propodos is straight and cylindrical, about half the length of the carpos, and is furnished at the distal extremity with a lanceolate point, which appears to represent a rudimentary dactylos anchylosed with it, and carries on its under surface a tuft or two of long hairs, directed backwards. The second pair of pereiopoda is long and slender, the carpos being multiarticulate and longer on the right side than the left. The posterior three pairs of pereiopoda are longer and more slender than in *Heterocarpus*, corresponding more with those of *Plesionika*, and are, moreover, furnished with spines on the posterior margin of the meros and ischium, which, however, are less numerous and not so large.

The pleopoda are biramose, narrow, subfoliaceous and tapering; the inner branch supports a long club-shaped stylamblys, the extremity of which is furnished with cincinnuli. The first pair has the rami short and unequal, and attached to a peduncle that has the extremity produced as a flat, squamous plate.

The females of this genus are extremely prolific, if I may judge from the number of ova that are borne by the few specimens obtained. The ova generally are small, smaller than those of *Heterocarpus*, and in *Nothocaris ocellus* the specimen obtained cannot carry less than ten thousand eggs, if the number on each of the pleopoda be equal to those on the first pair.

The branchial arrangement of the genus corresponds with that of *Heterocarpus* and *Pandalus*, as shown in the following table, and differs from that of *Plesionika* in the absence of a pleurobranchia from the second pair of gnathopoda.

Pleurobranchiæ,	...	...	1	1	1	1	1
Arthrobranchiæ,	...	...	1	1	1	1	1
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	1	r	r	r	r	r	...
	h	i	k	l	m	n	o

Observations.—In this genus all the mastigobranchiæ are of a rudimentary character, excepting those of the first pair of gnathopoda, and terminate in small hooks as in *Plesionika;* they vary in number and form in the different species, but never terminate in a straight process as in *Pandalus* and *Pandalopsis.*

Geographical Distribution.—There are three or four species of this genus in the Challenger collection, and these were all found in the Eastern Archipelago, between New Guinea and the Philippine Islands, in depths of less than 150 fathoms. I am inclined to think, from an examination of Professor A. Milne-Edwards' figures, that several species that he has classified as belonging to *Pandalus* belong to this genus, more particularly *Pandalus sagitarius*, *Pandalus geniculatus*, *Pandalus longicarpus* and *Pandalus brevirostris*, taken during the expedition of the "Travailleur."

Nothocaris rostricrescentis, n. sp. (Pl. CXIV. fig. 1).

Carapace dorsally smooth over the cardiac and lateral regions, anteriorly carinated over the gastric region and produced to a long, upwardly curved, crescent-shaped rostrum, which is smooth on the upper surface from near the apex to the orbits, armed with two teeth at the apex and five spines and two teeth on the frontal crest. A small antennal tooth stands near the outer canthus of the orbit, and a very small one at the fronto-lateral angle.

Pleon smooth, and but slightly compressed; third somite arcuate and posteriorly

produced in the median line; the two following somites are short; the sixth is about once and a half the length of the fifth.

Telson long, slender, slightly depressed in the dorsal median line, and furnished with three small spines on each side on the dorso-lateral surface. Appendages rather long, slender, armed with small, feeble teeth.

Length, entire (female),	60 mm. (2·3 in.).
„ of carapace,	18 „
„ of rostrum,	27 „
„ of pleon,	42 „
„ of third somite of pleon,	11 „
„ of sixth somite of pleon,	7 „
„ of telson,	11 „

Habitat.—Station 192, September 26, 1874; lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.; off the Ki Islands, south of New Guinea; depth, 140 fathoms; bottom, blue mud. One specimen. Trawled.

The carapace is smooth and polished, laterally compressed and elevated to a carina over the gastric region, where the crest is armed anteriorly with two large fixed teeth, and posteriorly with five movable spines furnished between with fine hairs (fig. 1, *r.c.*). The rostrum is as long as the carapace, curved obliquely upwards in a crescentic form, it is smooth on the upper surface, except for the presence of two small teeth near the apex, and armed on the lower margin, from base to apex, with fifteen evenly disposed teeth. The frontal margin of the carapace is armed with a small antennal and a smaller fronto-lateral tooth.

The pleon is smooth, having the third somite arcuate, slightly compressed dorsally and posteriorly produced, but not carinated; the sixth somite is very short.

The telson (fig. 1*z*) is laterally compressed, shorter than the outer ramus of the rhipidura, and dorso-laterally armed on each side with three small solitary spines.

The ophthalmopoda (fig. 1*a*) are longitudinally pear-shaped; each stands on a small pedicle at the extremities of the ophthalmic somite, near the outer angle of the orbit, and directed obliquely outwards and forwards. The ophthalmus is hemispherical, the circumference being indented by a crescentic extension of the margins, which is produced by the presence of a large ocellus or secondary eye. This is circular in form and projects beyond the surrounding surface. Although close to the margin of the true eye it is distinctly separated from it, and divided into larger facets than those that exist on the principal organ.

The first pair of antennæ (fig. 1*b*) carries a long, sharp stylocerite that reaches as far as the distal extremity of the third joint of the peduncle. The flagella are slender and as long as the rostrum.

The second pair of antennæ is slender and rather longer than the animal, and has a scaphocerite with parallel margins, the outer being armed with a strong tooth; it reaches to half the length of the rostrum.

The mandibles (fig. 1*d*) have a stout molar process, a strongly toothed psalistoma separated from it, and a three-jointed synaphipod, of which the terminal joint is the broadest.

The first pair of gnathopoda (fig. 1*h*) is subpediform and seven-jointed; the propodos is reflexed against the meros and ischium; the dactylos is broad and short; the basis carries a long ecphysis, and the coxa supports a short mastigobranchia and a small podobranchial plume.

The second pair of gnathopoda (fig. 1*i*) is long and straight, reaching to the middle of the rostrum, and terminates in three or four short spines; the coxa has neither mastigobranchia nor podobranchial plume, but there stands on the outer surface near the articulation a strong, stout, calcified plate, the function of which I have not been able to determine; the second joint or basis carries an ecphysis that is half the length of the next succeeding joint.

The first pair of pereiopoda (fig. 1*k*) is long and more slender than the second pair of gnathopda; the coxa carries a rudimentary basecphysis that terminates in a small hook, and also a fasciculus of long, slender, flexible hairs; the basis is short and the ischium long and produced to a strong tooth-like point on the anterior distal extremity, and it articulates obliquely with the meros, which is longer, and slightly tapering to the carpal joint; the latter is longer than the meros, and twice the length of the propodos, which gradually tapers, and terminates in a small, short, style-like dactylos, immersed in a terminal brush of hairs (fig. 1*k''*). The second pair of pereiopoda is minutely chelate, and unequal, the appendage on the left side being as long as the body of the animal from the orbit to the base of the telson, and having the carpos multiarticulate and as long as the ischium and meros; that on the right side is a little more robust than the left, about half the entire length of the animal, and has the carpos as long as the preceding two joints. The posterior three pairs of pereiopoda are similar to one another in appearance, increasing slightly in length posteriorly, and also in the spinous character of the ischium and meros; the dactylos is short, sharp, unguiculate, and fringed with spines on the inner surface.

The pleopoda are rather stiff, subfoliaceous, narrow and pointed, and furnished on the inner ramus with a small club-shaped stylamblys that diminishes in importance on each appendage posteriorly.

Observations.—With this species was associated a smaller damaged specimen which I believe belongs to *Plesionika spinipes*, but the spines on the posterior pairs of pereiopoda are reduced in number and size.

Nothocaris binoculus (Pl. CXIV. fig. 2).

Carapace smooth and free from a dorsal carina posterior to the frontal crest, which is slightly elevated and laterally compressed, and anteriorly produced to a long rostrum extending beyond the orbital margin more than the length of the carapace. The frontal crest is armed with five movable spines and the rostrum on the upper surface with six or seven teeth distantly situated from each other, two being close together near the apex, and the lower margin with ten or more and a fringe of hairs near the base.

The sixth somite of the pleon is but a little longer than the fifth, and the telson is not so long as the lateral plates of the rhipidura.

The above description is from a female specimen. The male is considerably smaller than the female, more slender in appearance, and has comparatively a longer rostrum, but in detail the features correspond.

	Female.	Male.
Length, entire, . . .	39 mm. (1·5 in.).	21 mm. (0·8 in.).
„ of carapace, . . .	12 „	6 „
„ of rostrum, . . .	15 „	12 „
„ of pleon, . . .	27 „	15 „

Habitat.—Station 190, September 12, 1874; lat. 8° 56′ S., long. 136° 5′ E.; Arafura Sea, south of New Guinea; depth, 49 fathoms; bottom, green mud. Four specimens; one male, and three females bearing ova. Trawled.

This species is smaller than either of the preceding, but corresponds in all the generic features. The dorsal surface is smooth and rather conspicuously elevated at the third somite of the pleon and somewhat compressed posteriorly. The sixth somite is short, not being quite so long as the telson, which is a little shorter than the lateral branches of the rhipidura.

The carapace has a dorsal crest over the frontal region, but not extending to the gastric; it is armed with four or five spines and two teeth (fig. 2, *r.c.*), tolerably close together, of which the posterior is the smallest and stands just anterior to the gastric region, and the anterior the largest, standing on the rostrum at a level corresponding with the distal extremity of the ophthalmopod. Beyond this point the rostrum gradually rises anteriorly with a slight curve, and is furnished with five small teeth, of which three are subequally distant from each other, whilst the fourth and fifth near the apex are close together. The lower margin is furnished with ten or more teeth that lie nearly horizontal with the surface and therefore less conspicuous.

The ophthalmopoda (fig. 2*a*) are short and pyriform, furnished posteriorly with an ocellus, the distal margin of which is in contact with the pigment of the ophthalmus for a minute extent.

The first pair of antennæ has the first joint deeply excavate and furnished with a

stylocerite that is co-equal with the joint in length; the second and third joints are short, cylindrical, and fringed with hairs, supporting at the distal extremity two slender flagella that are subequal in length.

The second pair of antennæ carries a scaphocerite that does not extend to half the length of the rostrum, and a flagellum that is about half as long again as the animal.

The mandible has the psalistoma well developed, and the synaphipod has the distal joint of greater diameter than the basal.

The other oral appendages offer no marked features to distinguish them from those of the other species.

The first pair of gnathopoda corresponds in general with the preceding, but has the three terminal joints distinguishable from each other, and the podobranchial plume is reduced to a rudimentary condition. The second pair is tolerably robust, has the basecphysis well developed and the rigid plate at the base ovate.

The pereiopoda are slender and rather short. The first pair has the carpos on the right side longer than on the left. The second pair has the appendage on the left side shorter and more robust than that on the right. The posterior three pair have the spines on the meros few and distant; the propodos is considerably longer than the carpos, and the dactylos is long, slender, sharp-pointed, and furnished at the base with several small spines. These three pairs of pereiopoda diminish in length posteriorly.

The first pair of pleopoda has the inner and anterior branch in the male developed in the form of an ovate, membranous petasma.

The rest of the animal offers nothing very conspicuous to distinguish it from others of the genus.

The male is more slender and smaller than the female, being only about two-thirds of its length, and the rostrum is proportionately longer, being about one-third the total length of the animal in the female, and half the length in the male.

Nothocaris ocellus, n. sp. (Pl. CXIV. fig. 3).

Carapace having the dorsal surface posterior to the gastric region smooth, anteriorly depressed, and laterally compressed into a carina that commences on the gastric region and is produced anteriorly to a long rostrum, which is armed on the upper margin with two small spines at the posterior extremity, five or six conspicuous teeth, and six or seven considerably smaller extending to the apex; on the lower margin there are six small teeth near the apex, and the posterior portion is smooth and fringed with long hairs.

Ophthalmopoda short, pyriform, having a distinct ocellus posterior to the ophthalmus.

First pair of antennæ extending to a length equal to the animal.
Second pair about half as long again.
Pereiopoda long and slender.

	Female.	Male.
Length, entire, . . .	64 mm. (2·5 in.).	52 mm. (2 in.).
„ of carapace, . . .	19 „	16 „
„ of rostrum, . . .	? „	23 „
„ of pleon, . . .	45 „	36 „
„ of third somite of pleon, .	10 „	9 „
„ of sixth somite of pleon, .	7 „	6 „
„ of telson, . . .	13 „	10 „

Habitat.—Station 201, October 26, 1874; lat. 7° 3′ N., long. 121° 48′ E.; near Samboangan, Philippine Islands; depth, 82 fathoms; bottom, stones, gravel. Two specimens; one male and one female. Trawled.

This species resembles *Nothocaris binoculus*, but it is large, and has the rostrum relatively shorter and armed with fewer spines and more teeth on the dorsal crest. It is free from the dorsal curvature at the third somite of the pleon so conspicuous in *Nothocaris rostricrescentis*.

The male is more slender than the female.

Female.—The carapace is posteriorly rounded on the dorsal surface and free from any trace of a carina until over the gastric region, where the lateral surface is anteriorly compressed, and a well-defined carina suddenly rises into a serrate crest on the frontal region, and projects into a long rostrum that is first depressed and then elevated, and is about one-fourth longer than the carapace. It is furnished with thirteen teeth on the upper margin, and two small posterior spines on the gastric region (fig. 3, *r.c.*); the posterior five teeth are larger, and the eight anterior, that range from the middle to the apex of the rostrum, are very small and are determinable only by the aid of a lens. On the distal half of the lower margin there are six teeth, somewhat larger than those on the corresponding portion of the upper, but less than those on the dorsal crest.

The ophthalmopoda are short and pyriform. The ocellus on the posterior surface is small, and its upper margin is in contact with the ophthalmus by a process from the latter dipping towards it.

The first pair of antennæ has the first joint of the peduncle deeply excavate to receive the ophthalmopoda, on the outer side is a flat and sharp-pointed stylocerite, at the base of which, on the outer side, stands a small curved process. The stylocerite suddenly narrows to a sharp point, the extremity of which does not reach beyond that of the first joint. The second joint is short, and with the third, which is the longer of the two, equals the first in length. These support two flagella, of which the

inner is slender at the base and tapers gradually to the extremity, and is nearly equal to the length of the animal; the outer is broad and flat at the base, gradually narrowing it becomes cylindrical, and tapers to the extremity, and it is a little longer than the inner. The under surface of the flattened portion is longitudinally channelled and is furnished with a series of membranous cilia.

The second pair of antennæ supports a small and not very conspicuous phymacerite, a small sharp tooth at the distal angle, and a scaphocerite which reaches to about half the length of the rostrum, and has the outer margin straight, thick and rigid; and separated from the squamous plate by a longitudinal channel. It is armed at the extremity with a sharp tooth that extends a little beyond the squamous portion, which somewhat suddenly enlarges at the base and then gradually narrows to the distal extremity, where it reaches beyond the base of the tooth on the outer margin. The inner margin is fringed with long ciliated hairs; the outer is smooth.

The mandibles are furnished with a hollow and broad apophysis, the outer surface of which is exposed and covered with a mat of short, fur-like hairs; the molar process is cylindrical, and projects at a right angle to the apophysis, and the psalistoma is produced from the curve, near which also springs the synaphipod; they lie close together and assume a similar appearance, the contiguous margins being uniform and in contact; the former is fixed and tipped with two or three teeth, while the synaphipod is broad, thin, curved and triarticulate, the terminal joint being quadrate, and tipped with short hairs.

The first pair of siagnopoda is three-branched; the outer branch is curved and bilobed at the extremity, where it is fringed with a few tolerably long, simple hairs; the second or middle branch is broad and flat, broader at the extremity than at the base, and has the inner margin fringed with ciliated hairs and the distal with short, strong, smooth spines; the third or inner branch is curved in a direction contrary to that of the outer, the concave margin is smooth, and the convex is fringed with short stiff hairs that gradually increase in rigidity until they become spines at the apex.

The second pair of siagnopoda consists of three foliaceous branches of extreme tenuity; the inner branch is bilobed and has the distal margin fringed with hairs, and among those on the basal lobe are a few strong spines; the median branch is short, flat, and tapers somewhat suddenly, especially towards the extremity, which forms a blunt point; the outer branch consists of a broad foliaceous plate of extreme tenuity, projecting anteriorly beyond the distal extremity of the inner plates, where it is obtusely rounded off, and posteriorly in a still broader and more rounded process, the entire margin of the plate being fringed with long ciliated hairs, which radiate centrifugally in the same direction.

The third pair of siagnopoda is three-branched; the inner branch is broad, flat, squamous and bilobed, each lobe being fringed at the distal and contiguous margins with a thick mat of hairs, closely placed towards the base; the second branch is

foliaceous at the base, and separated into two divisions; the inner, which consists of a small, narrow branch of great tenuity, projects a little beyond the preceding lobes, while the outer is broader, of extreme tenuity, and has the outer margin fringed with delicate ciliate hairs, and the inner traversed by a thicker margin that is prolonged into a fine subcylindrical process, sparsely fringed with hairs, which become more important towards the outer distal extremity; the third or outer branch is membranous and separated into an anterior and a posterior division; the anterior is flexible, long, narrow, and tapers to a small tooth-like point, while the posterior is broad, flat, ovate, and flexible.

The first pair of gnathopoda is subpediform; the coxa supports a rudimentary mastigobranchia, which terminates in two small rami; attached to the base there is a short and thick but well-developed podobranchial plume, and attached to the membranous articulation a small arthrobranchial plume; the basis carries a slender branch twice the length of the appendage; next to the basis follow two broad stout joints, which I take to represent the ischium and meros, the carpos, so far as I am able to decide, being fused with the propodos. The propodos is long, ovate, squamous, and concave, and has the outer lateral margin reflexed against that of the preceding joints, the inner or median margin approximating to the corresponding margin on the opposite appendage, and is thickly fringed with hairs and long, smooth spines; the dactylos is represented by a narrow joint that articulates in its entire width with the propodos, at its distal extremity it is short, broad, and thicker than the propodos, the inner surface being fringed with a thick brush of long, stiff hairs.

The second pair of gnathopoda is long, slender and pediform; the coxa carries no branchial plume and only the rudiment of a mastigobranchia, above the base of which is a large, projecting, disc-like plate, the significance of which I have not been able to determine; the basis is short and carries an ecphysis less than half the length of the next succeeding joint, which probably represents the ischium and meros combined. The next joint is more slender than the preceding and about half its length, and I presume represents the carpos; that which represents the propodos is shorter than the preceding, and gradually tapers to a point, which is armed with one or two small spines; the margins are fringed with hairs.

The first pair of pereiopoda resembles the second pair of gnathopoda in form, but is more slender owing to the meros and carpos being much longer; the dactylos is reduced to a mere point. The second pair of pereiopoda has the carpos on the left side nearly twice as long as that on the right. The third pair of pereiopoda is long; the meros reaching to a level with the distal extremity of the scaphocerite; the carpos is nearly as long as the meros; the propodos is a little more than half the length of the carpos; the dactylos is short and sharp-pointed, terminating in a distinct unguis. The fourth and fifth pairs resemble the third in form, but each is successively shorter.

The pleopoda are biramose, and foliaceous. The first pair has the branches unequal, but in the following pairs they are nearly equal and carry a long, cylindrical stylamblys attached to the inner and posterior branch. The posterior pair forming the lateral plates of the rhipidura, is subequal in length with the telson and fringed with ciliated hairs.

Male.—The male corresponds with the female in form, but is smaller and more slender, to judge from a single specimen of each, in which there is no evidence of age to assist in a comparison. The pleon is more compressed in the male than in the egg-bearing female, and all the parts are relatively similar, excepting that in the male the smaller branch of the first pair of pleopoda is developed into a large petasma, approaching somewhat to that which exists in the Penæidæ. The other pleopoda resemble those of the female, but support two stylamblydes.

Nothocaris geniculatus (A. Milne-Edwards) (Pl. CXVI. fig. 4).

Pandalus geniculatus, A. Milne-Edwards, Recueil d. Fig. Crust., 1883.

The carapace is smooth, the frontal region is slightly compressed and crested with five or six small articulating spines; the rostrum is upwardly curved, not quite so long as the carapace, and armed, for more than half its length on the upper margin, with eleven fixed and rigid teeth, directed almost horizontally forwards and closely pressed against each other; the distal extremity is smooth and free from armature; on the lower margin there are seven or more teeth, those at the extremity becoming feeble and diminishing in size.

The pleon is dorsally smooth and has the third somite elevated and posteriorly produced in the median line to a blunt point, which lies closely pressed against the surface of the fourth.

The telson is long, narrow and tapering.

	Female.	Male.
Length, entire, . . .	69 mm. (2·7 in.).	59 mm. (2·3 in.).
„ of carapace, . .	19 „	16 „
„ of rostrum, . .	13·16 „	13 „
„ of pleon, . . .	50 „	43 „
„ of third somite of pleon, .	11 „	8 „
„ of sixth somite of pleon, .	12 „	10 „
„ of telson, . .	14 „	11 „

Habitat.—Station 122, September 10, 1873; lat. 9° 5′ N., long. 34° 50′ W.; off Barra Grande, Brazil; depth, 350 fathoms; bottom, red mud. Seventeen specimens; six males and eleven females. Trawled.

The ophthalmopoda are short, and the ocellus is in immediate contact with the pigment of the ophthalmus.

The first pair of antennæ is nearly as long as the animal, and carries a sharp-pointed stylocerite at the outer side of the base of the first joint, which reaches to the extremity of that joint; at the base of the stylocerite, on the outer margin, there is a protuberance that is probably of use in retaining the ophthalmopod in position, and protecting the ophthalmus from contact with the sharp point of the antennal tooth.

The second pair of antennæ is but slightly longer than the first, and about the length of the animal, and carries a scaphocerite that is subequal with the rostrum.

The mandible has an oblique, smooth, ovate, molar process, and a psalistoma that is smaller at the base than at the serrate extremity; at the base there is attached a three-jointed synaphipod, the distal joint being flat and spatuliform.

The first pair of siagnopoda is three-branched; the outer branch is curved, rigid, and bifid, one process being tipped with a strong spine and the other with several hairs; the middle branch is broad, flat, and fringed with a series of spines and hairs; the inner branch is curved in a reverse direction to the outer, rapidly tapers to a point, and is fringed with stiff hairs chiefly prominent on the convex margin.

The second pair of siagnopoda is distinguishable from those of *Pandalus* by having the mastigobranchial plate short, posteriorly round, and not projecting into the branchial chamber.

The third pair of siagnopoda bears a close resemblance to those of other species of the genus.

The first pair of gnathopoda is deeply reflexed and supports a short, thick, mastigobranchial plate, which carries attached to it a podobranchial plume.

The second pair of gnathopoda is five-jointed; the first joint or coxa carries a rudimentary mastigobranchial appendage, at the base of which is a flattened disc-like plate that falls between and separates the base of the first pair of gnathopoda and the branchial plumes, and apparently supports the former appendage in position; the second joint is very short, supports a short, slender ecphysis, and is unyieldingly articulated with the next joint, which is extremely long, slender, and cylindrical; this is succeeded by one that is about half its length and a little more slender, and by a terminal joint that is subequal with the penultimate and slightly tapers to a rounded apex. The rest of the appendages bear a corresponding resemblance to those of other species.

The first pair of pereiopoda resembles in form that of the second pair of gnathopoda, but it is more slender and carries a longer basisal joint and no ecphysis. The second pair has the carpos long, slender, multiarticulate and subequal, the articulations are not well defined, but become more distinct as they approach the propodos, the last articulus equalling in length and thickness the palm of the latter joint. The three posterior pairs have the meros long, the anterior pair reaching to about the extremity of the rostrum, and are sparsely armed with long spines; the carpos is long, the propodos subequal with it, and the dactylos short.

There is nothing remarkable in the form of the pleopoda to distinguish them from those of other species, excepting perhaps in the posterior pair, which is armed at the outer angle of the diæresis with a fixed tooth and a movable spine.

The telson corresponds with that of most other species, although it is not quite so flat on the dorsal surface as in some of them, and has a spine or two on the dorso-lateral angle and spines and hairs at the terminal extremity.

Observations.—This species is evidently identical with that which has been figured by A. Milne-Edwards as having been taken during the expedition of the "Travailleur" in July 1882, in the Bay of Biscay, at a depth of 1350 metres. There are, however, slight differences between the two forms. Our specimens have invariably eleven or more teeth and five or six spines on the dorsal crest and upper margin of the rostrum, whereas A. Milne-Edwards' drawing shows six of the latter and only eight of the former on the upper margin, while the distal extremity is smooth, and the lower corresponds with that of the Barra Grande specimens. The three posterior pairs of pereiopoda in our specimens are also longer than in that of A. Milne-Edwards, since in ours the carpal extremity of the meros reaches quite to a level with the apex of the rostrum. The posterior projection of the dorsal surface of the third somite is not so conspicuous as that figured by A. Milne-Edwards. These variations in the details may perhaps depend upon the draughtsman's want of accuracy, or they may be correlated with a different habitat.

Nothocaris spiniserratus, n. sp. (Pl. CXXXII. fig. 1).

Carapace anteriorly carinated and produced to a rostrum that is equal with it in length. The crest is armed with three movable spines and the rostrum with three rigid teeth, of which the most anterior is placed about the middle of the rostrum; apex of rostrum bidentate, the upper tooth being the smaller; lower margin convex and armed with three minute teeth.

Pleon smooth, with the third somite strongly arched, the fifth somite longer than the fourth, and the telson long, narrow and subequal with the lateral plates of the rhipidura.

Ophthalmopoda pyriform, and furnished with a distinct ocellus.

First pair of antennæ reaching a little beyond the extremity of the rostrum.

Second pair of antennæ nearly as long as the animal, and furnished with a scaphocerite that is equal with the rostrum.

Second pair of gnathopoda robust.

First pair of pereiopoda slender. Second pair having a long, slender, and multiarticulate carpos; the posterior three pairs of pereiopoda carrying a long and slender dactylos.

Length, entire,	12	mm. (0·4 in.).
,, of carapace,	4	,,
,, of rostrum,	2	,,
,, of pleon,	8	,,
,, of third somite of pleon,	1·5	,,
,, of sixth somite of pleon,	2	,,
,, of telson,	3	,,

Habitat.—Station 304, December 31, 1875; lat. 46° 53′ 15″ S., long. 75° 12′ 0″ W.; Port Otway, Messier Channel; depth, 45 fathoms; bottom, green sand. Eight specimens; all but one being more or less damaged. Dredged.

This species forms an interesting transition to *Plesionika*. The posterior spines on the frontal crest of the dorsal surface, when examined under the microscope, are seen to have a distinct articulation with the base, but their form corresponds with that of the succeeding teeth on the rostrum instead of being cylindrical and spine-like as seen in other species. Each of these spines is anteriorly serrate with three little teeth that have the points rounded or directed towards the base, and this serrature is continued on the teeth on the rostrum, but decreases in importance anteriorly on each succeeding tooth, so that it is scarcely visible on the most anterior, which stands near the centre of the rostrum. Beyond the most anterior tooth the margin is smooth and curved slightly upwards, terminating in an apex with two small teeth, of which the upper is the smaller and the lower the most advanced. The inferior margin is convex in a curve that is a little more arched than that of the upper margin, and furnished with four small teeth that lie almost parallel with it, and are scarcely distinguishable by an ordinary lens. The frontal margin of the carapace is furnished with a strong antennal tooth and a small one at the fronto-lateral angle.

The body of the animal is generally smooth and exhibits no differential specific feature. As in most of the species in this and other allied genera the third somite is arcuate, a condition that produces a gibbous appearance when the animal is extended.

The ophthalmopoda are pear-shaped and furnished with a distinct and almost isolated ocellus.

The first pair of antennæ has the peduncle about half the length of the rostrum, having the first joint deeply excavated to receive the ophthalmopod, and furnished with a sharp-pointed stylocerite. The flagella reach a little beyond the extremity of the rostrum, the outer being the stouter and furnished with hairs and numerous long membranous cilia that appear to increase in number towards the distal extremity; the inner is much more slender than the outer, a little longer, and supports only a few hairs.

The second pair of antennæ carries a scaphocerite that is armed with a strong tooth near the rounded distal extremity, and a flagellum which, although broken at the extremity, yet shows evidence of being nearly as long as the animal.

The mandible carries a three-jointed synaphipod, the first joint of which is stouter than the two following; the psalistoma is long and slender, and separated from the short robust molar process.

The second pair of gnathopoda is tolerably robust and long.

The first pair of pereiopoda resembles it in form, but is shorter and more feeble and furnished with a few serrate spines at the carpal articulation. The second pair of pereiopoda is long and slender; the propodos is short and not broader than the carpos, which is long, slender, and multiarticulate, the articuli being numerous and short; the meros is also multiarticulate, the condition becoming very evident when the joint is treated with a reagent. The third pair of pereiopoda has the meros long and fringed with short spines, the carpos robust and anteriorly produced over the propodal articulation, the propodos more slender than the carpos, long and fringed with short spines, and terminally a long, strong, slightly curved dactylos that is armed with two teeth near the base on the inner or posterior margin. The fourth and fifth pairs of pereiopoda resemble the third but decrease in size posteriorly.

The pleopoda are strong and powerful appendages; the terminal pair, which forms the outer plates of the rhipidura, has the inner plates narrower than the outer, which are furnished with a diæresis that is armed on the outer margin with a free long spine and a short fixed tooth.

The telson is long, narrow, and tapering; it is armed on the dorso-lateral surface with six or seven short spines, and terminally with six, two of which are short and subcentral, two long, situated at the angles, and two very short and planted on the lateral margins outside the angles.[1]

Pandalus, Leach.

Pandalus, Leach, Malacos. Pod. Brit., tab. xl.
„ Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 383.

Anterior portion of the carapace carinated and produced to a long rostrum that is armed on the dorsal or upper surface with movable spines, intermingled with hairs, and on the lower surface with fixed and rigid teeth. Frontal margin without an orbital tooth, but having a long antennal tooth and a small tooth corresponding with the antero-lateral angle of the carapace.

Pleon smooth, compressed or narrow posteriorly. Third somite laterally more

[1] Since the above description was in type I have received from Dr. Bruce a specimen of an immature Macrura, captured this summer in the Mediterranean, off Malta, which is apparently nearly allied to this species, but certainly does not belong to it. The teeth on the dorsal crest are armed on their anterior margin with numerous small reversed teeth. The rostrum is smooth, and there are only three teeth on the crest of the carapace, and one on each side behind the orbit is quite as large and more boldly serrate than those on the dorsum.

For the purpose of identification I propose to call this latter form *Odontolophus serratus*, on the assumption that it is the young of some undescribed genus.

compressed than the preceding, dorsally arcuate and posteriorly produced to a point. Sixth somite longer than the fifth.

Telson longer than the sixth somite, narrow, tapering, dorsally flattened and laterally compressed, longitudinally armed with a few solitary spinules and tipped with long and short rigid spines.

Ophthalmopoda short and pyriform, supported on a small pedicle, having the ophthalmus proportionally large, and furnished with an ocellus that, in the typical species, *Pandalus annulicornis*, is slightly elevated and surrounded by the dark pigment of the ophthalmus.

First pair of antennæ longer than the rostrum, carrying two flagella, and furnished at the base with a stylocerite that is rounded at the apex, and but half the length of the joint which carries it.

Second pair of antennæ rather longer than the animal and carrying a scaphocerite that is nearly as long as the carapace, narrow and slightly tapering to the distal extremity, where it is rounded on the inner and furnished with a sharp tooth on the outer distal margin.

Mandibles having the psalistoma and molar process distinct, and supporting a well-formed three-jointed synaphipod.

First pair of siagnopoda small and three-branched.

Second pair having the outer or mastigobranchial plate produced posteriorly, slender and filamentous.

Third pair having the ecphysis of the basisal joint produced anteriorly, and tapering to a slender process.

First pair of gnathopoda having the carpos and propodos reflexed, and carrying a long basecphysis.

Second pair pediform, without a basecphysis, and carrying only the rudiment of a mastigobranchial appendage similar to those of the pereiopoda.

First pair of pereiopoda long, slender and simple. Second pair unequally long, slender and chelate, having the carpos long and multiarticulate. Three following pairs tolerably robust and terminating in a strong, short dactylos.

Pleopoda biramose and foliaceous.

The branchiæ consist of eleven pairs of plumes and may be tabulated as follows :—

Pleurobranchiæ,	...	...	1	1	1	1	1		
Arthrobranchiæ,	...	1	1	1	1	1	...		
Podobranchiæ,	1	...	...	...	...	...	...		
Mastigobranchiæ,	1	r	r	r	r	r	...		
	h	i	k	l	m	n	o		

Geographical Distribution.—The type species, *Pandalus annulicornis*, Leach, is European, and mostly found on the French and British coasts. Milne-Edwards records a

species from the Mediterranean, Dana one from the coast of Oregon, Dr. Stimpson several species from Madeira, Australia, and the northern shores of Eastern Asia, Sidney Smith several from off the eastern coast of America, and Sars others from off the Scandinavian shores.

Pandalus magnoculus, n. sp. (Pl. CXV. fig. 1).

Rostrum a little longer than the carapace, measured from the orbital margin; dorsally armed with from ten to twelve movable spines, intermingled with a fringe of ciliated hairs, and on the under side with six rigid teeth interspersed with a fringe of long and ciliated hairs. Dorsal surface of carapace carinated to the posterior extremity of the gastric region.

Pleon dorsally smooth to the posterior portion of the third somite, where it narrows and is produced posteriorly to a small sharp tooth, which is repeated on the next somite, but to a less degree; the sixth somite is twice as long as the fifth, greatly compressed laterally and produced posteriorly on each side to a sharp point.

Ophthalmopoda (fig. 1*a*) supporting a large reniform ophthalmus, the inner side of which is flattened and furnished with an ocellus connected by a process with the ophthalmus.

First pair of antennæ (fig. 1*b*) having a short, pointed, flattened stylocerite of great tenuity on the outer side of the first joint, which is deeply excavate to receive the eye; second and third joints short and terminating in two flagella, the upper and more robust of which is the shorter, the lower being slender and a little longer than the rostrum.

Second pair of antennæ carrying a scaphocerite that reaches to about two-thirds the length of the rostrum, and a flagellum that is fully once and a half as long as the animal.

Three posterior pairs of pereiopoda furnished with a row of movable spines; the carpos and dactylos are long, the latter being styliform.

	Female.	Male.
Length, entire, . . .	63 mm. (2·4 in.).	59 mm. (2·3 in.).
„ of carapace, . .	16 „	16 „
„ of rostrum, . .	25 „	18 „
„ of pleon, . . .	47 „	43 „
„ of third somite of pleon, .	8 „	8 „
„ of sixth somite of pleon, .	14·5 „	11 „
„ of telson, . . .	12 „	10 „

Habitat.—Station 166, June 23, 1874; lat. 38° 50′ S., long. 169° 20′ E.; near New Zealand; depth, 275 fathoms; bottom, Globigerina ooze; bottom temperature, 50°·8. Nine specimens; six males and three females. Trawled. Associated with *Nephrops thomsoni*.

Station 167, June 24, 1874; lat. 39° 32′ S., long. 171° 48′ E.; off the west coast of

New Zealand; depth, 150 fathoms; bottom, blue mud. Fourteen specimens; five males and nine females. Trawled. Length of largest female, 45 mm.; of largest male, 33 mm.

Observations.—A considerable number of specimens were taken, some with and some without ova. With them were several specimens of a very decided variety, in which the rostrum is longer, straighter, and armed with twelve spines on the upper side for half the distance between the orbit and the apex of the rostrum, and on the under surface with fifteen or sixteen teeth continued from the base to the apex. The flagella of the first pair of antennæ do not reach to the extremity of the rostrum, and the scaphocerite of the second is not half the length of the rostrum, while the flagellum is longer than the animal. In all other respects this form corresponds with the type, almost hair for hair and spine for spine. The eyes are of the same size and relative proportion.

The specimens taken at Station 167 were all smaller and many were gravid with ova, but I could detect no variation to warrant their specific separation. They were trawled 140 miles nearer shore.

Pandalus falcipes, n. sp. (Pl. CXV. fig. 2).

Anteriorly produced to a rostrum horizontal with the dorsal surface, and about once and a half as long as the carapace; armed on the upper surface with ten small spines, the posterior of which is on the gastric region and the anterior distant from the apex of the rostrum, which is broken off, and on the under surface with eight teeth, of which those near the apex are smaller than those near the base, which are long; posterior to the last the rostrum is excavate on the lower margin; the frontal margin carries a sharp, but not large, antennal tooth, and the fronto-lateral angle is produced to a small point.

Pleon smooth, having the third somite arcuate and dorsally compressed, but not produced to a point; the three posterior somites are laterally produced to a point.

Telson (fig. 2*z*) scarcely longer than the sixth somite, dorsally flat and laterally depressed, and armed on each side on the dorso-lateral surface with from six to eight solitary spinules, and tipped with others.

Ophthalmopoda (fig. 2*a*) short, thick and pyriform, supported on a small pedicle and furnished with an ocellus that is in contact with the ophthalmus.

First pair of antennæ (fig. 2*b*) subequal with the rostrum, having the peduncle less than half the length of the latter; first joint excavate and furnished with a short, obtusely pointed stylocerite.

Second pair of antennæ about half the length of the animal, carrying a scaphocerite that reaches to more than half the length of the rostrum.

First pair of gnathopoda having the distal joint reflexed, and carrying a long ecphysis.

Second pair five-jointed, long and straight; basisal joint carrying a small, thread-like ecphysis, and the extremity terminating in two or three spinules and no dactylos.

First pair of pereiopoda six-jointed; ischium distally produced at the lower angle and articulating with the meros obliquely; penultimate joint long, and the terminal one styliform, the dactylos probably being wanting. It supports no branchia, but carries a short, rudimentary mastigobranchial plate. Second pair having the right appendage not very long; carpos multiarticulate and terminating in a small chela. The mastigobranchia is a rudimentary curved plate, terminating in a sharp point; that on the fifth side is wanting. Terminal three pairs of pereiopoda moderately long and robust, carrying a long, slightly curved, style-like dactylos, and furnished on the ischium and meros with sharp, spine-like teeth.

First pair of pleopoda having the rami unequal; the others subequal and foliaceous. The terminal pair, which helps to form the rhipidura, is subequal in length with the telson; the outer ramus possesses a diæresis that is armed with a movable spinule on the outer margin.

Length, entire,	53 mm. (2 in.).
„ of carapace,	13 „
„ of rostrum,	18 „
„ of pleon,	40 „
„ of third somite of pleon,	10 „
„ of sixth somite of pleon,	9 „

Habitat.—Station 49, May 20, 1873; lat. 43° 3′ N., long. 63° 39′ W.; south of Halifax, Nova Scotia; depth, 85 fathoms; bottom, gravel, stones; bottom temperature, 35°·0. Two specimens; male and female. Dredged.

This species may be identical with *Pandalus levigatus*, Stimpson,[1] which was dredged off the Island of Grand Manan, Bay of Fundy, on rocky bottoms in the Laminarian zone, but that species is very imperfectly described. Stimpson says that it differs from *Pandalus borealis*, Kröyer, in the want of dorsal spines on the third and fourth somites of the pleon, and in having only eleven superior spines or serrations on the rostrum, which are situated only on the posterior two-thirds of its length. Its colour is usually a very pale yellow, with narrow blue lines on the back.

Our type specimen has ten spinules on the dorsal surface of the rostrum, and in this respect it corresponds with the specimen before me, as well as with Leach's figure, of the European type of the genus, *Pandalus annulicornis*, to which it bears a close affinity. It may be readily distinguished by its long, sickle-shaped dactylos, from which the specific name is chosen.

The rostrum is produced more horizontally in a line with the dorsal surface of the

[1] Synopsis of the Marine Invertebrata of Grand Manan, p. 58.

carapace and does not curve upwards as in *Pandalus annulicornis;* it is, moreover, not so deep at the base in front of the ophthalmic excavation, and it carries longer teeth. The third somite of the pleon is less arcuate and not so much produced on the dorsal surface, and the telson is adorned with more spines on the dorso-lateral surface.

The smaller of the two specimens taken is more slender, but undoubtedly the same species; it is 28 mm. long., and the rostrum 9 mm.

Pandalus modestus, n. sp. (Pl. CXIV. fig. 4).

Carapace smooth, anteriorly produced to a rostrum about half the length of the carapace; fronto-dorsal region armed with spines that are continuous to the apex of the rostrum, which is furnished with teeth on the lower margin.

Pleon smooth; third somite arcuate, sixth a little longer than the fifth.

Telson as long as the sixth somite.

Ophthalmopoda large, orbicular.

First antennæ having the peduncle subequal with the rostrum.

Second antennæ as long as the animal.

First pair of pereiopoda slender, terminating in a long, straight dactylos. Second pair of pereiopoda unequal. Posterior three pairs having the ischium and meros armed with small spinules.

Posterior pair of pleopoda as long as the telson.

Length, entire,	17	mm. (0·6 in.).
„ of carapace,	5	„
„ of rostrum,	2·7	„
„ of pleon,	12	„
„ of third somite of pleon,	3	„
„ of sixth somite of pleon,	3	„
„ of telson,	2·5	„

Habitat.—Station 142, December 18, 1873; lat. 35° 4′ S., long. 18° 37′ E.; at the Agulhas Bank, off the Cape of Good Hope; depth, 150 fathoms; bottom, green sand; bottom temperature, 47°. Three specimens. Dredged.

The carapace is anteriorly armed on the frontal region with four or five spinules, and there are four or five on the upper margin of the rostrum and three or four teeth on the lower; the frontal margin beyond the orbit has no well-defined teeth and the general surface is smooth.

The dorsal surface of the pleon is smooth; the third somite is dorsally rounded and somewhat elevated but not posteriorly produced to a cusp or tooth. The sixth somite is a little longer than the preceding, and the telson is quite as long.

The ophthalmopoda are short and globular.

The first pair of antennæ (fig. 4*b*) has the peduncle subequal in length to the rostrum, the first joint corresponds with the length of the ophthalmopod and supports a short and round-pointed stylocerite; the second joint is short, and the third still shorter and cylindrical; it terminates in two flagella subequally long and but little longer than the peduncle, the outer being robust and the inner very slender.

The second pair of antennæ carries a scaphocerite that reaches beyond the extremity of the rostrum and a flagellum that is as long as the animal.

The oral appendages have not been examined.

The second pair of gnathopoda is tolerably robust and reaches as far as the extremity of the rostrum.

The first pair of pereiopoda (fig. 4*k*) is slender and terminates in a long, straight and styliform extremity tipped with a few hairs, planted at right angles to the surface of the joint. The second pair of pereiopoda (figs. 4*l*, 4*l'*) is unequally long and slender. The posterior three pairs are moderately long and terminate in a long, sharp-pointed, curved dactylos, armed on the inner surface with two teeth (fig. 4*m*); the propodos is long, cylindrical, and armed on the flexor surface with two long and several short spines; the carpos distally overlaps the base of the propodos, and is armed with two small spines on the posterior and flexor margin; the meros is long, slender, cylindrical, and armed on the posterior margin with several small spines.

The first pair of pleopoda is single, the four succeeding are double-branched, and the posterior pair is subequal in length with the telson.

Pandalopsis, n. gen. (A. Milne-Edwards *in litt.*).

Resembles *Pandalus*, but has the flagella of the first pair of antennæ slender, and both branches longer than the carapace.

The single species of this genus in the Challenger collection is the only one that I have had an opportunity of examining. Beside the relatively greater length of the flagella of the first pair of antennæ, it differs from *Pandalus* in having the second pair of gnathopoda more robust, the meros having the inner margin longitudinally developed into a squamiform process fringed with long hairs, in having a broad squamiform process anteriorly projecting on the under side of the ischium, and in having a pleurobranchia above the second pair of gnathopoda and no mastigobranchia posterior to the first pair of pereiopoda.

Pandalopsis amplus, n. sp. (Pl. CXV. fig. 3).

Carapace smooth and polished; fronto-lateral margin armed with an antennal and a fronto-lateral tooth, compressed anteriorly in the dorsal median line, elevated to a crest over

the frontal and gastric region, and produced to a long and slender rostrum which is armed superiorly with thirteen movable spines interspersed with short hairs. Rostrum longer than the carapace, smooth on the anterior half of the upper margin, directed slightly upwards and armed on the lower surface with thirteen or fourteen rigid teeth interspersed with short hairs.

The pleon is smooth and polished; the third somite is slightly compressed dorsally, and slightly arcuate, the posterior margin being mesially produced posteriorly, and overlapping the fourth somite; the sixth somite is nearly twice the length of the fifth. The telson is long, narrow, dorsally flat and laterally compressed, each dorso-lateral surface being longitudinally armed with seven small movable spines, of which the posterior stands at the distal angle, while the extremity is furnished with three small spines and a few hairs.

The ophthalmopoda (fig. 3*a*) are pyriform, in consequence of the smallness of the stalk on which they stand. The ophthalmus is quite or nearly hemispherical, the posterior margin of the pigment extending at one point to form a rudimentary ocellus.

The first pair of antennæ (fig. 3*b*) has the first joint deeply excavate for the reception of the ophthalmopod, and carries on the outer side a stylocerite that is not at all style-like, being a smooth, round disc, produced anteriorly. In this it resembles *Pandalus annulicornis* and *Pandalus falcipes*. The second and third joints are cylindrical, extending to nearly half the length of the rostrum, and distally supporting two flagella, of which the outer is the larger and somewhat the longer, equalling in length the entire animal. This character furnishes a ready diagnosis of this species from *Pandalus*, the flagella of which do not reach beyond the extremity of the rostrum, and are about the length of the carapace.

The second pair of antennæ offer nothing very remarkable excepting that the scaphocerite is long, being nearly the length of the carapace. The margins are subparallel, the outer being rigid and terminating in a sharp tooth near the apex.

The mandibles have the molar process long, with the grinding surface ovate; the psalistoma is narrow and bidentate. The first joint of the synaphipod is broader than the two succeeding, which terminate in a rounded extremity.

The oral appendages possess a strong resemblance to the typical species, as do also the two pairs of gnathopoda, the second pair having no ecphysis, which is present in its near ally, *Nothocaris*.

The first pair of pereiopoda (fig. 3*k*) is a little more slender than the second pair of gnathopoda, and has the terminal joints less hirsute. It is remarkable also for the large squamiform development of the ischial joint, the lower margin of which is fringed on the inner side with a row of hairs. The second pair is like that in *Pandalus annulicornis*, but more uniform in length and strength on each side. The three posterior pairs have only one spine on the ischium and six on the meros, subequally distant, and three on the carpos.

The mastigobranchiæ are reduced to a useless or rudimentary condition, the extremity of each falling short and not penetrating behind the branchial plumes. They all possess this character, and are fringed with hairs on the lower margin and terminate in a sharp point supplemented with two others that reversely meet at their points to form a small uniarticulate claw.

The first pair of pleopoda in the male has the branches unequal; the inner is short, foliaceous, and subapically furnished with a stylamblys. The rest have the branches equal, but the second carries two compressed stylamblydes and all the others one. The last pair, which helps to form the rhipidura, has a well-marked diæresis on the outer branch, the outer limit of which is armed with two small teeth.

	Female.	Male.
Length, entire,	62 mm. (2·4 in.).	105 mm. (4·1 in.).
„ of carapace,	15 „	28 „
„ of rostrum,	25 „	38 „
„ of pleon,	47 „	77 „
„ of third somite of pleon,	7 „	16 „
„ of sixth somite of pleon,	13 „	15 „
„ of telson,	12 „	22 „

Habitat.—Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; off Monte Video; depth, 600 fathoms; bottom, green sand; bottom temperature, 37°·2. Six specimens; five males and one female. Trawled.

Observations.—Three of the specimens differ from the typical form in having the rostrum more curved towards the apex, but since I cannot detect any other difference I believe them to be a variety that may not be uncommom.

The species resembles in general form *Pandalus propinquus*, Sars, from which it differs in generic characters only, viz., in the length of the first pair of antennæ, in the form of the second pair of gnathopoda and first pair of pereiopoda, in having the rostrum less curved upwards at the extremity and the teeth on the lower margins smaller and more numerous.

Chlorotocus, A. Milne-Edwards.

Chlorotocus, A. Milne-Edwards, Rapport Commiss. pour la faune sous-marine, p. 18, 1882; Recueil de Fig. de Crust., 1883.

Animal smooth and even, not carinate, nor denticulate, excepting on the rostrum. No orbital or hepatic tooth, and only a small first antennal one on the frontal margin.

Ophthalmopoda moderately large, pyriform, and furnished with an independent ocellus.

First pair of antennæ biflagellate, short, and furnished with a sharp-pointed stylocerite.

Second pair of antennæ long and slender, and furnished with a sharp-pointed scaphocerite.

Mandibles having the psalistoma distinct from the molar process, and furnished with a biarticulate synaphipod.

Second pair of gnathopoda long, slender, pediform, and furnished with a long basecphysis.

First pair of pereiopoda six-jointed and simple. Second pair feebly chelate, and having the carpos biarticulate.

Geographical Distribution.—Professor A. Milne-Edwards took his specimen of *Chlorotocus gracilipes* during the expedition of the "Travailleur" on July 27, 1881, at a depth of 332 to 370 metres, in the Gulf of Gascony.

Its length was about 50 mm.

Chlorotocus incertus, n. sp. (Pl. CXVI. figs. 1, 2).

Animal smooth. Carapace anteriorly produced to a slender rostrum, armed with teeth above, extending as far posteriorly as the dorsal crest, and also on the under surface.

The ophthalmopoda are short and pyriform.

The first pair of antennæ is short.

The second pair of antennæ is long and slender.

The mandible carries a psalistoma and a two-jointed synaphipod besides the molar process.

The first pair of pereiopoda is simple. The second is slender, chelate, and has the carpos biarticulate. The three posterior pairs of pereiopoda are slender, and terminate in a long dactylos.

The telson is broad at the base and tapering.

Length, entire,	. . . . .	39 mm. (1·5 in.).
„	of carapace, ...	13 „
„	of rostrum, ...	? 9 „
„	of pleon, ...	26 „
„	of third somite of pleon, ...	5 „
„	of sixth somite of pleon, ...	3 „
„	of telson, ...	5 „

Habitat.—Station 142, December 18, 1873; lat. 35° 4′ S., long. 18° 37′ E.; Agulhas Bank, off the Cape of Good Hope; depth, 150 fathoms; bottom, green sand; bottom temperature, 47°. One specimen. Dredged.

The carapace is dorsally rounded and smooth, excepting on the frontal crest and rostrum, the former of which is armed with four teeth, and the latter on the upper surface with other four, so far as known; the lower surface is armed with two teeth, at which point the rostrum is broken off. The frontal margin has the orbit but feebly indicated, and the first antennal tooth tolerably developed, whence it gradually slopes to the lateral margin.

The pleon is smooth, and terminates in a telson that rapidly tapers to a point.

The ophthalmopoda (fig. 1*a*) are pyriform, having the ophthalmus nearly half the depth of the whole; it is furnished with a large independent ocellus, and at the base of the ophthalmopod there are a few slightly ciliated hairs.

The first pair of antennæ (fig. 1*b*) has the peduncle shorter than the rostrum; the first joint is excavate on the upper surface, fringed with ciliated hairs on the inner margin, and furnished on the outer with a triangular stylocerite, the inner margin of which is fringed with five long simple hairs. The second and third joints are cylindrical, and tipped with fasciculi of long simple hairs, and terminate in two unequal flagella, the outer being robust, the inner slender and thread-like.

The second pair of antennæ (fig. 1*c*) is about as long as the animal, and carries a scaphocerite that is a little longer than the peduncle of the first pair of antennæ, and is probably subequal with the length of the rostrum.

The mandibles (fig. 1*d*) are narrow, and have the psalistoma distinct from the molar process, and support a moderately long two-jointed synaphipod.

The first pair of siagnopoda (fig. 1*e*) is three-branched; the outer branch is distally square, supporting a stiff ciliated hair at each angle; the middle branch is ovate and furnished with a mat of hairs on the inner surface, and the inner branch is short and fringed with hairs and stiff spines.

The second pair of siagnopoda (fig. 1*f*) consists of three branches and a large mastigobranchial plate; the first branch is short, broad, and fringed with hairs; the second is bifid, each lobe being broad and ciliated; the third branch is cylindrical, tapering, and tipped with hairs. The mastigobranchia is broad, projects anteriorly as far as it does posteriorly, and is fringed with a series of centrifugally directed hairs.

The third pair of siagnopoda (fig. 1*g*) is three-branched; the first branch is bilobed, the basal lobe being small and the distal large, ovate, and fringed with hairs; the second is cylindrical, biarticulate and flagelliform, and is sparsely fringed with hairs; at the base stands a bilobed mastigobranchia.

The first pair of gnathopoda (fig. 1*h*) is short, broad, seven-jointed, and distally reflexed; it is furnished with a long, slender, flagelliform basecphysis, and the coxa carries a short, triangular, mastigobranchial plate; the several joints are fringed with hairs, those on the inner distal margin increasing in character to fringed spines.

The second pair of gnathopoda (fig. 1*i*) is four-jointed, long, slender, and fringed with

hairs; the coxa is short, smooth, and carries a short and sharp-pointed rudiment of a mastigobranchial plate; the basis is short, furnished on the inner side with three fasciculi of ciliated hairs, and supports a long, slender ecphysis; the third joint, which probably is the ischium and meros combined, is long and slender and fringed with simple hairs on the inner side only, excepting for a short distance on the outer side at the base, and bears at the distal extremity a single plumose hair; the third joint, which probably represents the carpos, is curved at the base to enable it to be flexed against the inner margin of the preceding joints, it is fringed both on the inner and outer side with a series of fasciculi of simple hairs; the fourth or terminal joint, representing the propodos, is long, cylindrical, and tapering at the point, and is fringed on both the inner and outer margins with a series of long hairs, having a fasciculus of short ones at the base of each.

The first pair of pereiopoda (fig. 1*k*) is six-jointed and chelate; the coxa is short and stout; the basis is short and furnished with long simple hairs on the inner margin, and a rudimentary ecphysis of membranous character on the outer; the ischium is long, cylindrical, and fringed with long and simple hairs on the inner margin; the meros is a little longer than the ischium, and fringed on both the inner and outer margins with a series of long and short hairs, distally placed in fasciculi; the carpos is long and narrow, narrower on the inner side near the base to enable it to be flexed more perfectly against the preceding joints, and fringed on both inner and outer margins with long, simple hairs; the terminal joint or propodos is not more than half the length of the carpos, fringed on both sides with slender bundles of simple hairs, and terminates in a sharp unguiculate point. The second pair of pereiopoda is slender, chelate, and has the carpos biarticulate. There is but one of the appendages of this pair preserved, so that I cannot say if it be unequal or not. The propodos is long, and the pollex and dactylos short. The three following pairs of pereiopoda are slender, having the meros and ischium posteriorly fringed with short teeth, and terminate in a fringed propodos, and a long and styliform dactylos. Each of the pereiopoda excepting the posterior pair is furnished with a rudimentary mastigobranchia.

The pleopoda are short and biramose; those of the sixth pair are subequal with the telson in length, and are fringed with hairs.

The branchiæ (fig. 2) consist of a series of five small arthrobranchiæ and six large pleurobranchiæ, but no podobranchiæ and only rudimentary mastigobranchiæ, as shown in the accompanying table :—

Pleurobranchiæ,	...	1	1	1	1	1	1
Arthrobranchiæ,	...	1	1	1	1	1	...
Podobranchiæ,	...	...	...	...	...	...	...
Mastigobranchiæ,	1	1	1	1	1	1	...
	h	i	k	l	m	n	o

Dorodotes,[1] n. gen.

Carapace smooth, laterally compressed and dorsally carinated, anteriorly produced to a rostrum armed with a series of teeth above and below.

Pleon smooth but slightly compressed laterally; third somite posteriorly produced on the dorsal surface; fourth and fifth somites laterally cleft at the posterior margin between the somite and coxal plates.

Telson long and narrow.

Ophthalmopod small and uniarticulate.

First pair of antennæ twice the length of the carapace, and furnished with a sharp-pointed stylocerite.

Second pair of gnathopoda pediform, and furnished with a long basecphysis.

First pair of pereiopoda simple. Second pair chelate; having a long, slender and flexible, multiarticulate carpos. Three posterior pairs of pereiopoda tolerably robust, having the meros and ischium armed with small spines; carpos not so long as the propodos; dactylos styliform.

Pleopoda biramose and subfoliaceous; the anterior branch carrying a single stylamblys. Outer branch of the rhipidura furnished with a distinct diæresis.

All the pereiopoda except the posterior pair carry a rudimentary mastigobranchia tipped with a little hook. The branchial arrangement differs from that of *Pandalus*, in having two arthrobranchial plumes attached to the second pair of gnathopoda, as shown in the annexed table:—

Pleurobranchiæ,	...	...	1	1	1	1	1		
Arthrobranchiæ,	...	2	1	1	1	1	...		
Podobranchiæ,	1	...	...	...	...	...	...		
Mastigobranchiæ,	1	r	r	r	r	r	...		
	h	i	k	l	m	n	o		

Observation.—This genus very closely resembles *Chlorotocus*, A. Milne-Edwards, but differs chiefly in the character of the second pair of pereiopoda, which has the carpos multiarticulate in *Dorodotes* and biarticulate in *Chlorotocus*.

Geographical Distribution.—I only know of one species of this genus, and this has been taken twice, in the Sea of Banda and near Manila, on the northern shores of the Philippine Islands, where the largest specimen was trawled.

[1] δωροδότης, a bestower.

Dorodotes reflexus, n. sp. (Pl. CXVI. fig. 3).

Carapace smooth. Carinated dorsally over the gastric and frontal regions, and produced to a laterally compressed rostrum that is about one-half the length of the carapace, serrate on the upper and lower margins with closely pressed, anteriorly directed sharp teeth.

Pleon smooth and but slightly compressed laterally in the three posterior somites; third somite dorsally produced posteriorly in the median line but neither compressed nor dentated; fourth and fifth laterally cleft posteriorly between the somite and the coxal plates, the postero-lateral angle of which is rounded in the fourth and produced to a sharp point in the fifth, while in the sixth it culminates in a strong tooth.

Telson narrow, dorsally flat and laterally compressed, the angles armed with long spines.

Ophthalmopoda short, ophthalmus small and round.

First pair of antennæ about twice the length of the carapace, carrying a strong sharply pointed stylocerite.

Second pair of gnathopoda long and robust, more so than the first pair of pereiopoda, which is slender and terminates in a small dactylos.

Length, entire (male),	. . . . .	78 mm. (3 in.).
„ of carapace,	. . . . .	28 „
„ of rostrum,	. . . . .	12 „
„ of pleon,	. . . . .	50 „
„ of third somite of pleon,	. . . .	12 „
„ of sixth somite of pleon,	. . . .	7 „
„ of telson,	. . . . .	13 „

Habitat.—Station 195, October 3, 1874; lat. 4° 21′ S., long. 129° 7′ E.; near Banda Island; depth, 1425 fathoms; bottom, blue mud; bottom temperature, 38°. One specimen; male. Trawled.

Station 205, November 13, 1874; lat. 16° 42′ N., long. 119° 22′ E.; Philippine Islands; depth 1050 fathoms; bottom, blue mud; bottom temperature, 37°. Two specimens, male and female. Trawled.

The rostrum is slightly elevated anteriorly and is broadest at the base, whence it gradually tapers to the apex, there being no excavation on the under surface for the reception of the eye-stalks. It is about one-third the length of the carapace, armed on the lower margin with four or five sharp teeth, and on the upper with fourteen or fifteen, the posterior gradually becoming smaller and placed closer together towards the termination of the carina on which they stand, and which dies out just over the cardiac region,

behind which, in advance of the posterior margin, there is in the median line a small circumscribed tubercle. The frontal margin of the carapace has the outer canthus of the orbit defined by an obtuse point within the first antennal tooth, which is small, as is also that of the second.

The ophthalmus is small and round, being smaller in diameter than the ophthalmopod on which it stands (fig. 3*a*).

The first pair of antennæ has the peduncle subequal in length with the rostrum; the first joint, which equals the length of the other two, is depressed to a greater extent than is necessary to receive the eye and has no blepharos or fringe of reversely directed cilia on the anterior upper surface, but carries a long stylocerite, sharp at the apex but horizontally dilated within the extremity. The flagella are slender and about twice the length of the carapace, the outer and upper in the male being a little more robust than the inner.

The second pair of antennæ carries a long and narrow scaphocerite that reaches considerably beyond the rostrum, and the flagellum is longer than the animal.

The branch attached to the basisal joint of the first pair of gnathopoda is long, and that attached to the second is slender, single-jointed and flexile.

The first pair of pereiopoda is less robust and shorter than the second pair of gnathopoda, and terminates in a lanceolate dactylos. The second pair carries a tolerably robust chela and the articulations of the carpos are rather distant. The three posterior pairs have the posterior margin of the ischium and meros sparsely armed with strong spine-like teeth. The coxal joint of the last three, as shown most distinctly in the posterior pair, has a broad and flat posterior plate that checks the backward movement of the legs. This joint in all the pereiopoda except the posterior carries a small rudimentary mastigobranchia, which terminates in a small hook. The mastigobranchia belonging to the second pair of gnathopoda exhibits a peculiarity that exists in most of its congeners, but is very pronounced in this species. Instead of springing directly from the coxa as in all the pereiopoda it arises vertically from the centre of a rigid and scarcely articulating basal plate which springs perpendicularly from the coxa and penetrates between the branchial plumes, separating that of the first pair of gnathopoda from those of the second.

The pleopoda are biramose and subfoliaceous; the anterior branch carries on the inner side a long stylamblys, subapically furnished with a corona of cincinnuli, except in the first pair, which has the inner and anterior branch shorter and more membranous, and terminates in a point which carries the stylamblys, the margins being furnished with thickly set plumose cilia. The outer branch of the posterior pair, which helps to form the rhipidura, has two longitudinal ribs: the outer runs diagonally from the base to the outer angle of the diæresis and terminates in two small teeth, the second is central and contains the muscles that act upon the terminal plate.

The telson is dorsally flat, with the sides depressed and the longitudinal line between the two strengthened by a ridge and armed with four long sharp spines, the posterior being situated at the terminal angles. These spines are evidently under the will and control of the animal, and are capable of being erected so as to be perpendicular to their base, and of being used as offensive weapons. This appears still more evident from the fact that the animal has the power of becoming dorsally flexed considerably beyond a horizontal line, the extent of which is shown in the shortness of the dorsal length of the first two somites, which are transversely bisected by a narrow groove.

Observations.—This species presents several points of extreme interest, which I do not think can be considered as generic. One is the extreme length of the two posterior pleurobranchiæ; in the largest specimen they are so long that their apical extremities are reflexed and folded back against the upper surface of the branchial chamber. Another feature of interest is the deep cleft that exists, more particularly in the fifth somite, between it and the coxal plate which belongs to it. Again in several congeneric forms in this small group, the dorsal crest is armed with teeth, in others with spines, and in some with both teeth and spines. In this genus the rostrum is armed entirely, both above and below, with sharp teeth that in this species are anteriorly directed almost parallel with the general line of the animal, but it is worthy of notice that several of the posterior teeth show a depression or groove at the anterior basal portion, apparently indicating a tendency for the conversion of the rigid teeth into movable spines.

Dorodotes levicarina, n. sp. (Pl. CXII. fig. 5).

Carapace smooth, lateral carinæ subdued; median dorsal line slightly carinated and armed with eleven teeth, the posterior standing on the pyloric region and the anterior near the apex of the rostrum, which is half the length of the carapace, and on the lower side with six small teeth.

Pleon slightly compressed, dorsally carinated, the carina on the third, fourth and fifth somites terminating posteriorly in a small tooth.

Telson tapering, not longer than the outer rami of the rhipidura.

First pair of antennæ scarcely longer than the rostrum.

Second about half the length of the animal.

Outer rami of the rhipidura broad and furnished with a diæresis, the outer angle of which is near the distal extremity.

Length, entire (male),	39	mm. (1·5 in.).
„ of carapace,	12	„
„ of rostrum,	9	„
„ of pleon,	27	„
„ of third somite of pleon,	5·5	„
„ of sixth somite of pleon,	3	„
„ of telson,	6	„

Habitat.—Station 188, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; Arafura Sea, south of Papua; depth, 28 fathoms; bottom, green mud. Two specimens; males. Trawl and dredge both used.

This species is remarkable for its smoothness, but when it is in a dry condition the lines of the lateral carinæ on the carapace are appreciable, appearing as very slight elevations. One carina corresponds with the orbital tooth, and the other commences at the posterior margin, runs forward and unites with the first on the hepatic region. The dorsal carina is likewise less conspicuous than in the typical forms of the genus and is not elevated into a prominent crest.

On the pleon the carina is indicated on all the somites, but more especially on the third, fourth, and fifth, where it culminates on each posteriorly in a small sharp tooth.

The ophthalmopoda are pear-shaped and the ophthalmus hemispherical.

The first pair of antennæ carries a stylocerite that is sharply pointed and reaches beyond the distal extremity of the first joint, and a flagellum that is scarcely longer than the rostrum; the outer flagellum in the male is much more robust than the inner. The second pair supports a scaphocerite that tapers to the extremity and terminates in an external tooth.

The pereiopoda are rather short; the three last pairs are serrate on the posterior margin, and each terminates in a long dactylos.

Observations.—Two specimens of this intermediate form were taken in the shallow sea south of New Guinea. They are interesting as showing the value in classification of the lateral carina and the passage of one form into another.

The species bears a near resemblance to *Chlorotocus gracilipes*, A. Milne-Edwards, from the West Indies, and it would, indeed, have been classified in the same genus had not A. Milne-Edwards figured the carpos of the second pair of pereiopoda as being uni-articulate, a character which approximates it to *Thalassocaris* of Stimpson (*Regulus* of Dana), whereas *Dorodotes* is structurally nearer *Pandalus*.

Tribe **Monocarpidea.**

The genera in this tribe consist of those forms that differ from the Polycarpidea in having the carpos of the second pair of pereiopoda formed of a single joint, and generally the chela of this pair larger than that of the first. As in the preceding tribe the genera may conveniently be divided into those which have the first pair of pereiopoda monodactyle and those in which they are didactyle, or chelate, and to this tribe may also be added a third division, comprising those in which all the pereiopoda are monodactyle.

Family Thalassocaridæ.

Carapace dorsally smooth, anteriorly produced to a laterally compressed rostrum. Pleon narrow, laterally compressed and tapering to a pointed telson truncated at the tip. First antennæ having a stylocerite and terminating in two flagella. Second antennæ furnished with a scaphocerite that is rigid on the outer margin and armed with a tooth. First pair of pereiopoda simple; second chelate. Pleopoda foliaceous and biramose. Rhipidura well developed.

Thalassocaris, Stimpson.

Thalassocaris, Stimpson, Proc. Acad. Nat. Sci. Philad., p. 42, January 1860.
Regulus, Dana, U.S. Explor. Exped., Crust., vol. xiii. p. 597 (*nom. præocc.*).

Animal slightly compressed; carapace more than one-third its length. Rostrum elongate and dentate. Frontal margin produced to a tooth corresponding with the first pair of antennæ, but without a second antennal or fronto-lateral tooth.

Pleon more compressed than the carapace; somites subequal and laterally produced to a point; sixth somite longer than the preceding. Telson nearly as long as the sixth somite.

First pair of antennæ biflagellate.

Second pair of antennæ long, slender, and furnished with a sharp pointed scaphocerite.

First pair of pereiopoda long, slender, and styliform. Second pair more robust than the first pair and chelate. Three following pairs simple.

Pleopoda two-branched, terminal pair well developed, foliaceous, rounded at the extremity and subequal with the length of the telson.

Dana states as one of the characters of the genus that the third somite of the pleon is dorsally produced to a spine. It was so produced in the two species known to him, and such is also the case with those in the Challenger collection, but there is a closely allied specimen that is dorsally nearly smooth, and I hesitate to consider this character as

generic, seeing how variably the dorsal teeth on the pleon are distributed among the species of the same genus.

Geographical Distribution.—One of Dana's species was taken at the Ladrone Islands and the other in the Sulu Sea. Of those in the Challenger collection, one was taken off the Fiji Islands and the other off Japan and the Philippine Islands. Stimpson records *Thalassocaris fucida*, Dana, from the Pacific Ocean.

Observation.—The species of this genus appear to connect those of the family Pandalidæ with those of the family Palæmonidæ.

Thalassocaris danæ, n. sp. (Pl. CXVII. fig. 1).

Carapace dorsally smooth, anteriorly slightly compressed, and produced to a rostrum which is rather longer than the carapace and serrate superiorly from the frontal crest to the apex with a series of small teeth. Frontal margin furnished with an antennal tooth.

Pleon having the somites subequal; third somite posteriorly produced to a large dorsal tooth; lateral margins of the coxal plates produced to a sharp point which is longest in the first and second and gradually lessens posteriorly; sixth somite more slender and narrower than the preceding. Telson rather longer than the sixth somite and gradually tapering to a point.

Ophthalmopoda robust and large rather than long.

First pair of antennæ not reaching beyond the apex of the rostrum.

Second pair of antennæ about as long as the animal. Scaphocerite sharply pointed and armed with teeth on the outer margin.

First pair of pereiopoda slender and styliform. Second pair short and robust. Three following pairs longer than the second and terminating in a simple dactylos.

Pleopoda biramose, terminal pair not longer than the telson.

Length, entire,	9	mm. (0·3 in.).
,, of carapace,	3	,,
,, of rostrum,	4	,,
,, of pleon,	6	,,
,, of dorsal tooth on third somite,	1	,,
,, of sixth somite of pleon,	1	,,
,, of telson,	1·5	,,

Habitat.—Fiji Islands; at the surface. One specimen.

The carapace is rounded posteriorly and a little compressed anteriorly, slightly crested and produced to a rostrum that is slightly longer than the carapace, and armed on the upper surface with a regular series of small teeth commencing on the frontal crest and continued to the distal extremity, which is slightly curved upwards. The under margin

is smooth and free from teeth, excepting two or three small points near the apex. The frontal margin is furnished with a tooth at the outer angle of the orbit corresponding with the position of the first antennal tooth, beyond which there appears to be no other tooth.

The pleon has the somites subequal, the sixth being cylindrical, a little longer and narrower than, but not so deep as, the fifth and preceding somites. The third somite carries a tooth at the posterior extremity of the dorsal surface that is as long as the sixth somite or as the telson, which tapers to a sharp point.

The ophthalmopoda are about one-fourth the length of the rostrum, slightly pear-shaped and about half as thick as long.

The first pair of antennæ (fig. 1*b*) has the first joint a little longer than the ophthalmopoda, the second and third very short, cylindrical, and supporting two slender flagella that reach nearly to the extremity of the rostrum.

The second pair of antennæ (fig. 1*c*) has the second joint of the peduncle produced to a sharp tooth at the inner distal extremity, and carries a long and trigonal scaphocerite, the distal extremity of which runs to a sharp point, the outer margin being armed near the middle with three strong sharp teeth, and the inner fringed with recurved teeth and fine ciliated hairs. The third joint is obliquely articulated on the inner side of the second; it is cylindrical, and articulates at its extremity with the fourth joint, which carries at its extremity a long and slender flagellum, the basal articuli of which are fused together for a distance equal to about half the length of the scaphocerite.

The oral appendages have not been examined, as the specimen is a solitary one and the species of the genus that are known are not numerous.

The first pair of pereiopoda is slender and styliform, and carries a basecphysis. The second pair is scarcely as long as the first, more robust, and terminates in a well-developed chela of which the propodos is thick and the fingers shorter than the palm; this pair also appears to be furnished with a basecphysis. The third and fourth pairs are slender, longer than the preceding, terminate in a rather long and slender dactylos, and carry a rudimentary basecphysis. The fifth pair shows no evidence of a basecphysis and terminates in a dactylos that is shorter than those of the preceding pairs.

The pleopoda are biramose; those of the sixth pair are subequal in length and do not reach beyond the distal extremity of the telson.

Thalassocaris stimpsoni, n. sp. (Pl. CXVII. fig. 2).

Carapace dorsally smooth, anteriorly produced to a rostrum that is straight, laterally compressed, and about half the length of the carapace.

Pleon smooth except for a tooth on the posterior margin of the third somite. The sixth somite is a little longer and narrower than the fifth.

Telson long and tapering slightly to the extremity, which is armed at each angle with a strong spine and with six smaller spinules between them.

Ophthalmopoda pyriform.

Second pair of pereiopoda imperfectly chelate, the pollex being shorter than the dactylos, and the propodos not of greater diameter than the carpos.

	Japanese specimen.	Fiji specimen.
Length, entire, . . .	10 mm. (0·4 in.).	7 mm. (0·3 in.).
„ of carapace, . .	3·5 „	3·3 „
„ of rostrum, . .	2·5 „	2 „
„ of pleon, . . .	6·5 „	4 „
„ of dorsal tooth, . .	0·5 „	0·5 „
„ of sixth somite of pleon, .	1·5 „	1·5 „
„ of telson, . . .	1·5 „	1·5 „

Habitat.—Japan, near Yokohama, June 17, 1875; surface. One specimen.

Fiji Islands, August 11, 1874; surface. Two specimens.

The carapace is about one-third the length of the animal, measured from the orbital margin to the extremity of the telson. It is dorsally smooth and carries a straight, smooth, and sharply pointed rostrum, which is about one-third shorter than the carapace.

The pleon, including the telson, is about twice the length of the carapace, and the sixth somite is of the same length as the telson. The dorsal surface is smooth except for a tooth in the median line on the posterior margin of the third somite.

The telson gradually narrows posteriorly, the terminal extremity being truncated and armed with a long spine at each angle and six small spines between them.

The ophthalmopoda are pear-shaped, about half the length of the rostrum and projected on a slender stalk.

The first pair of antennæ has the peduncle about two-thirds the length of the rostrum, the first joint is slightly concave, wide at the base, and armed on the outer margin with a short sharp stylocerite. The second and third joints are short and cylindrical, and terminate in two flagella that are subequal in length with the peduncle, and reach beyond the rostrum to a distance equal to half its length; the inner flagellum is slender and thread-like and the outer robust.

The second pair of antennæ is a little more than half the length of the animal, and carries a scaphocerite that is subequal in length with the rostrum. The outer margin is smooth, straight, rigid, and terminates in a sharp and slender point, the inner is convex, membranous, and fringed with ciliated hairs; it is widest near the base and gradually tapers to the distal point.

The oral appendages have not been examined.

The gnathopoda are pediform, the second pair being much longer than the first, both being furnished with basecphyses.

The first pair of pereiopoda is long, slender and simple. The second terminates in an imperfect chela, the pollex being about half the length of the dactylos, but this inequality may be due to the imperfectly developed character of the specimen. The third and fourth pairs are slender, simple, and longer than the preceding, and like them carry a basisal appendage of considerable length. The fifth pair is shorter than the preceding and does not carry an appendage, nor is the basisal joint quite as important as in the four preceding pairs, which are remarkable for their length and robust appearance.

The pleopoda are biramose. The first pair has the branches unequal, the inner being small and rudimentary. The succeeding pairs have the branches subequal, the inner carrying a single stylamblys. The sixth pair has the rami subequal, and about the same length as the telson; the outer plate is armed with a feeble tooth at the outer distal angle, and the inner and outer margins as well as the rounded extremity are fringed with slender ciliated hairs.

The hairs everywhere on the animal appear to be ciliated, on the legs as well as on the other parts.

Observations.—There were two specimens taken off the Fiji Islands that correspond much with the one described, and which I consider to belong to the same species. The chief distinctions between them exist in the length of the ophthalmopoda, their projection upon long and slender stalks, and the greater length of the scaphocerite as compared with the rostrum, which nearly corresponds in length with that in the specimen from Japan, but differs in having three minute teeth on the upper margin. These however are visible only in a lateral view and with increased magnifying power.

In the Fiji specimens the hairs on the legs instead of being ciliated are smooth.

The second pair of pereiopoda in both specimens has the chela broken off, and the pleon has the third somite armed with a stronger tooth than in the Japanese specimen.

Diaphoropus,[1] n. gen.

Animal slender. Carapace not more than one-third the length of the animal, anteriorly produced to a horizontal rostrum.

Pleon smooth; somites subequal.

Telson tapering, slender.

Ophthalmopoda robust.

First pair of antennæ biflagellate.

Second pair furnished with a foliaceous scaphocerite; flagellum long and slender (?).

Mandible without a synaphipod.

First pair of pereiopoda slender and terminating in a straight styliform dactylos. Second pair robust, chelate. Third and fourth pairs short, simple, and terminating in a

[1] διάφορος, different; πούς, foot.

biunguiculate dactylos. Fifth pair very long, slender, and terminating in a biunguiculate dactylos.

Pleopoda biramose, ultimate pair subequal in length with the telson.

Geographical Distribution.—Species of this genus have been captured in the Australian seas and in the Atlantic off the Cape Verde Islands.

Observation.—This genus is evidently the immature condition of some undetermined form.

Diaphoropus versipellis, n. sp. (Pl. CXVII. fig. 3).

Carapace long, cylindrical, anteriorly produced to a rostrum that is twice the length of the ophthalmopod, which is short and stout.

Peduncle of first antennæ subequal with the rostrum. Scaphocerite subequal with the peduncle of the first pair of antennæ, flagellum (probably) long and slender.

First pair of pereiopoda terminating in a straight and style-like unguis. Second pair robust, long and chelate; fingers about half the length of the palm, carpos short. Two succeeding pairs terminating in a biunguiculate dactylos. The fifth pair reaches beyond the ophthalmopoda and terminates in a biunguiculate dactylos.

Length, entire,	. . . . .	9 mm. (0·3 in.).
„ of carapace,	. . . . .	3 „
„ of pleon,	. . . . .	6 „

Habitat.—Off Cape Howe, Australia, April 3, 1874. Surface, at night.

The carapace is one-third the length of the animal and rather deeper than the walls of the pleon, and has the surface smooth except for a small tubercle on the gastric region; it is anteriorly produced to a sharp rostrum lying in the plane of the dorsal surface, and about half the length of the carapace. The frontal margin is excavate to form orbits, the outer angles of which correspond with the first antennal tooth, whence the margin recedes and unites immediately with the lateral margin, which continues in a line subparallel with the dorsal surface to the posterior extremity of the carapace, the lateral angles of which are rounded and increased in depth.

The first somite of the pleon is long and divided into an anterior and a posterior section. The second is still longer, being subequal with the third, fourth and fifth, all of which are smooth and free from any dorsal depression. The sixth is subequal in length with the preceding and with the telson.

The ophthalmopoda are short and stout, not exceeding half the length of the rostrum and about a third less broad than long.

The first pair of antennæ has the first joint of the peduncle longer than the

ophthalmopod, and the third joint, which is subequal with the second, reaches to the extremity of the rostrum and terminates in two short flagella.

The second pair of antennæ carries a long flagellum, but it is broken off a little behind the distal extremity of the scaphocerite, which reaches to the length of the peduncle of the first pair, is rounded at the extremity and fringed with hairs, the outer angle being furnished with a strong tooth.

The mandibles are without a synaphipod.

The first pair of pereiopoda (fig. 3*k*) is long and slender; the meros is long, the carpos and propodos gradually enlarge and then as gradually decrease in thickness anteriorly to that of the dactylos, which terminates in a long straight unguis, the base of which bears a hair or two. The second pair (fig. 3*l*) is short, robust, and chelate; the carpos and propodos continuously enlarge at first and as gradually decrease to the extremity of the dactylos and form a long ovate chela, the fingers of which are about half the length of the palm of the propodos. The third (fig. 3*m*) and fourth pairs resemble each other; they are short, and terminate in a biunguiculate dactylos that is about one-third the length of the propodos. The fifth pair (fig. 3*o*) is very long and slender, reaching anteriorly as far as the extremity of the ophthalmopoda. It is remarkable for the large size of the coxal joint, which is broad at the base but rapidly narrows to the diameter of the basis, and generally lies directed forwards.

The pleopoda are all biramose, the posterior pair not being longer than the telson.

Observations.—This specimen is one of interest from the remarkable state of transition which it exhibits. It is evidently a young animal that is passing from one stage to another, the change almost corresponding in degree to a metamorphosis. The antennæ and other appendages are seen in a higher state of development within the older skin that is about to be shed, but the fifth pair of pereiopoda, which in the adult state terminates in a biunguiculate dactylos, is inclosed within an older case that is produced to a long and slender point, more than four times its length, and fringed at the extremity on the concave side with a series of small reversed teeth.

Diaphoropus longidorsalis, n. sp. (Pl. CXVII. fig. 4).

Carapace long, cylindrical, carrying a short, pointed rostrum. Frontal margin without an antennal tooth; fronto-lateral angle produced to a small tooth.

Pleon having the five anterior somites subequally long; sixth somite as long as the two immediately preceding.

Telson nearly as long as the sixth somite.

Ophthalmopoda short and thick, but twice the length of the rostrum.

First antennæ twice the length of the ophthalmopod.

Second antennæ possessing a scaphocerite that reaches as far as the distal extremity of the peduncle of the first pair.

The oral appendages have not been examined.

The appendages of the pereion are uniform, excepting the posterior pair of pereiopoda, which is long, slender, and reaches to the distal extremity of the first antenna.

The pleopoda are short and biramose; the sixth pair is subequal in length with the telson.

Length, entire,	. . . . .	9 mm. (0·3 in.).
„ of carapace,	. . . . .	3·5 „
„ of rostrum,	. . . . .	0·5 „
„ of pleon,	. . . . .	5·5 „

Habitat.—Cape Verde Islands, April 26, 1876.

This species resembles *Anebocaris quadroculus* (Pl. CXXIII. fig. 1), in which the anterior pair of pereiopoda is chelate, but differs from it in having a shorter rostrum. It appears to be in a younger stage of development, as all the pereiopoda except the posterior pair are furnished with long basecphyses, and none of them exhibit the chelate condition shown in the second pair of the preceding species.

Kyptocaris,[1] n. gen.

Animal slender. Carapace short, anteriorly produced to a horizontal rostrum. Frontal margin having the orbit slightly excavate; lateral angle produced to a sharp tooth.

Third somite of the pleon as long as the preceding two, and dorsally arcuate; fourth somite articulating at a right angle with the preceding; sixth somite long and laterally compressed.

Telson long and slender.

Ophthalmopoda long, narrow, and articulating by a slender pedicle.

First pair of antennæ biflagellate.

Second pair having a slender flagellum and a long and foliaceous scaphocerite.

Second gnathopod long, slender, and seven-jointed.

First pair of pereiopoda short and simple. Second pair chelate. Third, fourth, and fifth pairs simple and subequal.

Posterior pair of pleopoda subequal in length with the telson.

Geographical Distribution.—There is only one species, and of that but one specimen, in the collection. It was obtained in the Philippine Sea.

[1] *κυπτός*, bent; *καρίς*, shrimp.

Kyptocaris stylofrontalis, n. sp. (Pl. CXXI. fig. 1).

Carapace short, dorsal crest armed with two small teeth. Rostrum long, slender, and styliform.

Third somite of the pleon turgid; sixth somite longer than the preceding two and posteriorly furnished with a slender dorsal tooth.

Telson half the length of the sixth somite.

Ophthalmopoda nearly as long as the carapace, clavate.

Length, entire,	7	mm. (0·2 in.).
„ of carapace,	1·4	„
„ of rostrum,	1·4	„
„ of pleon,	5·6	„
„ of third somite of pleon,	1	„
„ of sixth somite of pleon,	2	„
„ of telson,	1	„
„ of ophthalmopod,	1·3	„

Habitat.—October 23, 1874, off Sibago, Samboangan, Philippine Islands; surface.

The carapace is one-fifth the length of the animal, armed on the frontal crest with two small teeth, and anteriorly produced to a long, slender, sharply pointed rostrum that is quite half as long as the carapace. The frontal margin is armed with a slender infraorbital tooth, and the fronto-lateral angle is produced to a sharp tooth, behind which, on the lateral margin, there is another smaller one.

The first somite of the pleon is divided into two subequal portions; the second is as long as the first, and laterally overlaps the somite both anterior and posterior to it; the third somite is as long as the two preceding, and is elevated to a hump, but the articulation of the posterior margin with the fourth somite is, as in the genus *Caricyphus*, subparallel with the dorsal surface; the fourth somite is shorter than the third, and the fifth shorter than the fourth; the sixth somite is longer than the preceding two together, and posteriorly produced to a sharp and slender tooth.

The telson is half the length of the sixth somite.

The ophthalmopoda are long, slender, and clavate, nearly equal in length to the carapace, and projected upon a small pedicle.

The first pair of antennæ has the first joint of the peduncle longer than the rostrum, and the second and third joints short and subequal; each of the two flagella is biarticulate.

The second pair of antennæ has the flagellum very slender in consequence of the length of each articulus, rather than of the number of them; the second joint is robust, armed with a tooth on the outer side, and supports a scaphocerite that is subequal in length with the peduncle of the first pair.

The oral appendages have not been examined in this solitary specimen.

The second pair of gnathopoda (fig. 1*i*) is long, slender, and pediform, longer than any of the pereiopoda, which it resembles in the number of the articulations, but differs in having the meros and propodos longer and the carpos and dactylos shorter.

The first pair of pereiopoda (fig. 1*k*) is monodactyle, and has the carpos and propodos subequal and the dactylos short. The second pair (fig. 1*l*) is more robust than the first, and chelate. The third (fig. 1*m*), fourth, and fifth pairs are rather more slender than the second, subequal in length, and terminate in a sharp and longer dactylos.

Family Atyidæ.

Carapace dorsally smooth, rounded, and anteriorly produced to a flattened rostrum. Pleon short and robust. First antennæ having a stylocerite. Second carrying a short scaphocerite. Mandibles having a molar process and psalistoma but no synaphipod. Second pair of gnathopoda four-jointed and pediform. First and second pairs of pereiopoda chelate, dactylos and pollex spatuliform or spoon-shaped. Third, fourth, and fifth pairs simple. Pleopoda biramose. Rhipidura well developed. Telson flattened, truncate.

Atya, Leach.

Atys, Leach, Trans. Linn. Soc. Lond., vol. xi. p. 345, 1815.
Atya, Leach, Zool. Miscell., vol. viii. p. 29, 1817.
„ Latreille, Règne Anim. de Cuvier, tom. iv. p. 93.
„ Desmarest, Consid. sur les Crust., p. 215.
„ Roux, Mem. class. crust. Salicoques, p. 27; Férussac, Bull. Sci. Nat., tom. xxvii., 1831.
„ Wiegmann, Wiegmann's Archiv f. Naturgesch., Jahrg. iii. p. 145, 1836.
„ Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 347, 1837.
„ Newport, Ann. and Mag. Nat. Hist., vol. xix. p. 158, 1847.
„ A. Milne-Edwards, Ann. Soc. Entom. France, tom. iv. p. 145, 1864.
Atyoida, Randall, Journ. Acad. Nat. Sci. Philad., vol. viii. p. 140.

Animal laterally compressed, dorsally smooth. Frontal margin produced to a rostrum in line with the carapace, not laterally compressed.

First and second pairs of pereiopoda short and chelate; chelæ fringed with long hairs. Third pair large and long; fourth and fifth robust and shorter than the third.

Pleopoda short, broad, and foliaceous.

Rhipidura short, robust, and well developed.

The carapace is quite one-third the length of the animal, and in some species more. The dorsal surface projects to a rostrum and is anteriorly depressed in the same continuous line; it is flat and broad at the base and tapers to the apex.

The pleon is also laterally compressed, and is as deep anteriorly as the carapace, but posteriorly it gradually tapers to the extremity of the telson, corresponding with the line of the dorsal surface.

The ophthalmopoda are short but free.

The first pair of antennæ terminates in two flagella.

The second pair of antennæ carries a broad foliaceous scaphocerite armed with a tooth on the outer margin, and a long flagellum.

The mandibles have a psalistoma that is continuous with a molar process, but there is no synaphipod.

The gnathopoda are short and membranous.

The first two pairs of pereiopoda are short, submembranous, and chelate, with the extremity of the pollex and dactylos furnished with long hairs. The third pair is simple, long, and very robust. The fourth and fifth are shorter and robust.

The pleopoda are short and foliaceous. The rhipidura is well developed and robust, the telson being shorter than the lateral plates.

The description of the form to which Randall has given the name of *Atyoida* so closely corresponds with *Atya* that it is difficult to see how it can be retained as a separate genus. It is undoubtedly smaller in size, and has the posterior three pairs of pereiopoda comparatively more feeble in character and proportionally smaller and subequal in size.

Dana, in his great work, expresses the opinion that "among the species of *Atya* there is a very great difference as to the relative size of the third and following pairs of legs; and it seems possible that the transition may be such as to render it unnecessary to sustain the genus *Atyoida*."

A close examination of the structural details confirms this opinion of Dana, and I therefore place *Atyoida* in this Report under *Atya*, as at present it appears to me that the weight of our experience leads to the belief that the two named forms are but different species of the same genus.

Development.—Among the numerous specimens of *Atya* (*Atyoida*) *bisulcata*, procured in the market at Honolulu, there were several females carrying ova, of a long ovate form (Pl. CXXII. fig. 2*ov*), and of these one or two specimens had the embryo so far advanced in development that on rupturing the egg-case I was able to determine the form of the brephalos.

This is in an advanced Zoea stage (Pl. CXXII. fig. 2), corresponding with that of the marine forms of the normal Phyllobranchiata, differing from that of *Crangon* only in the absence of a tooth on the third somite of the pleon, and considerably resembling that of *Alpheus*, from which it differs in not having the ophthalmopoda detached from the frontal margin of the carapace, but large and apparently continuous with it. This, however, is a consequence of its embryonic condition, and probably

does not exist in those specimens that become fully matured, and escape under natural circumstances.

The carapace is well developed, and is about a third of the length of the animal, reaching as far as the extremity of the developed pereion.

The first pair of antennæ has a two-jointed peduncle that folds back against itself, and terminates in two slender branches, the rudiments of the future flagella, one of which is thick at the base and styliform, and the other slender and thread-like.

The second pair of antennæ consists of a single-jointed base supporting a long and wide plate, the scaphocerite, which is distally fringed with five or six long ciliated hairs, and a slender flagellum that is about half the length of the scaphocerite.

The mandibles have not been determined.

Posterior to the oral aperture there are three pairs of biramose appendages, which from analogy with the brephalos of *Crangon* represent, I believe, the maxillipedes and first and second gnathopoda.

The pleon is six-jointed, well developed, and terminates in a broad and foliaceous plate, fringed on each side of a deeply excavate median cleft with five long hairs and two spines; at the base of each of the former there is a thin crenated plate.

None of the pleopoda are yet apparent even in the most immature condition.

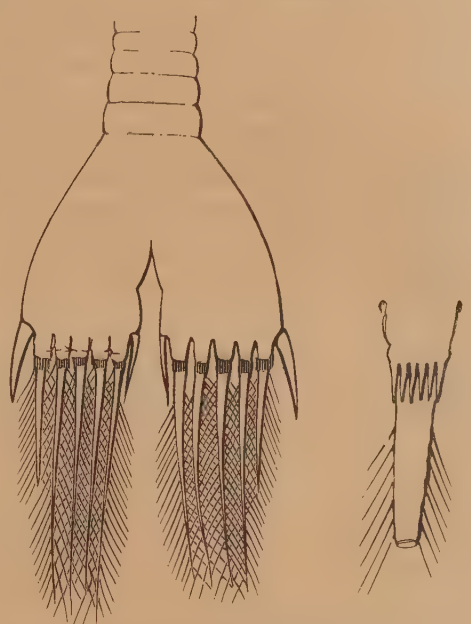

Fig. 71.—*Atya bisulcata.* Telson of Zoea; and one hair from the posterior margin, enlarged to show the serrate plate at its base.

Observation.—Whatever changes the form undergoes in the development of the first and second pairs of pereiopoda must take place at a stage later than that in which they exist in the condition of the brephalos.

Geographical Distribution.—The habitat of the original specimen described and figured by Leach under the name of *Atys scabra*, which he afterwards changed to *Atya scabra*, has not been recorded, but since Leach's specimen has been found to correspond with *Atya mexicana*, Wiegmann, it may be assumed to have been found in the fresh-water rivers or ponds of Mexico or the West Indian Islands.

According to Newport and A. Milne-Edwards there are eight species of *Atya* already known, of which *Atya scabra* and *Atya occidentalis* are from Mexico and the West Indies, *Atya sulcatipes*, of which a figure is given on Pl. CXVIII., is from the Cape Verde Islands, *Atya robusta* and *Atya margaritacea* are from New Caledonia, *Atya*

armata, *Atya spinipes*, and *Atya pilipes* are from New Zealand. The last two are probably only varieties of the same species, since their distinction chiefly rests on the presence or absence of a smaller tooth posterior to that described as being on the under side of the meros of the third pair of pereiopoda in *Atya armata*.

Of the smaller species, which has been described under the generic name of *Atyoida*, specimens of *Atya bisulcata* have been recorded from the Islands of the Pacific, Randall, Dana, and Stimpson having obtained it from Hawaii. Stimpson has described a species that is difficult to separate from the above, but to which he has given the name of *Atyoida tahitensis*, from its having been procured at Tahiti. Specimens in the Challenger collection were obtained at Honolulu, which I cannot distinguish from *Atya bisulcata*. Fritz Müller obtained specimens, that he named *Atyoida potimirim*, from the fresh-water rivers of South America. Specimens that correspond closely with those from the Pacific Islands were procured during the voyage of the Challenger from the Cape Verde Islands. I have named them *Atya serrata* from the only distinguishing feature by which I could positively identify them. They were found associated with *Atya sulcatipes*, and with a damaged specimen of *Caridina typus*, which I am inclined to think may be only the young of the last named *Atya*.

Atya sulcatipes, Newport (Pl. CXVIII.; Pl. CXIX. fig. 1).

Atya sulcatipes, Newport, Ann. and Mag. Nat. Hist., vol. xix. p. 158, pl. iii. fig. 1, 1847.
" " A. Milne-Edwards, Ann. Soc. Entom. France, tom. iv. p. 147, 1864.

This species closely resembles the typical form of *Atya scabra*, but differs in having a prominent tooth on the inner distal angle of the carpos.

Length, entire,	68	mm. (2·6 in.).
" of carapace,	26	"
" of rostrum,	0·3	"
" of pleon,	42	"
" of first, second, and third somites, each	6	"
" of fourth, fifth, and sixth somites, each	5	"
" of telson,	9	"
" of peduncle of first antenna,	8	"
" of scaphocerite,	8	"
" of first pereiopod,	18	"
" of second pereiopod,	20	"
" of third pereiopod,	47	"
" of fourth pereiopod,	30	"
" of fifth pereiopod,	25	"

Habitat.—From a fresh-water stream in the valley of San Antonio, San Iago, Cape Verde Islands.

The dorsal surface from the rostrum to the sixth somite is finely punctated with shallow depressions. Those on the carapace are confluent, while on the pleon they form small round hollows independent of each other. The surface of the carapace in the median line projects anteriorly to a rostrum that equals the length of the first joint of the first pair of antennæ, or about twice the length of the ophthalmopod. On each side of the median line is a deep groove that extends as far back as the orbital region, and gives the appearance of a carina to the median line, which, however, is not elevated above the rest of the carapace. The outer ridge of these grooves is longitudinally elevated and anteriorly produced, and indicates the inner canthus of the orbit, which forms a semicircle, the outer canthus being produced to a short point; the margin then curves round the base of the second pair of antennæ and is produced at the fronto-lateral angle to a sharp and rather prominent tooth, whence it recedes downwards obliquely to the postero-lateral angle, which is the deepest portion of the lateral margin of the carapace.

The pleon is anteriorly as deep as the carapace, equally compressed, it gradually lessens in depth posteriorly in a ratio nearly similar to the lessening of the depth of the carapace anteriorly, a circumstance that is due to the gradual and regular decrease of the somites and coxal plates posteriorly.

The telson (Pl. CXVIII., z) is dorsally grooved, the groove widening to the posterior lateral angles, the curved line of which is longitudinally armed with six small spines, and there is also one on the outer angle of the posterior margin, which is fringed with a row of hairs, in the centre of which is a small tooth representing the posterior extremity of a small longitudinal ridge which occupies the median line of the posterior portion of the groove.

The ophthalmopoda (Pl. CXIX. fig. 1) are short, scarcely reaching beyond the projecting point of the inner canthus of the orbit; the ophthalmus is small, orbicular, and not larger than the peduncle.

The first pair of antennæ (Pl. CXVIII., *b*) has the first joint of the peduncle subequal with the rostrum in length, excavate on the upper surface to receive the ophthalmopod, and furnished on the outer side with a sharp pointed stylocerite, that is shorter than the joint and fringed with hairs near the distal extremity. The second joint is subequal in length with the first, subcylindrical, and furnished on the upper and outer surface with a mat of short coarse hairs; the third joint is half the length of the preceding, longer on the inner than on the outer side, and terminally supports two flagella, of which the inner is the longer and more slender and the outer short and robust.

The second pair of antennæ (*c*) is nearly as long as the animal and carries a scaphocerite that reaches as far as the extremity of the peduncle of the first pair; it is broad, foliaceous, and fringed at the extremity with ciliated hairs and strengthened on the outer margin by a strong ridge that terminates in a tooth, which is little more than half the distance from the base and lies embayed within the edge, from which point a

diæresis similar to that which exists on the outer plate of the rhipidura bisects the appendage.

The mandibles (*d*) are strong; the molar process is robust and obliquely truncate, and from the lower side a thin wall fringed with hairs passes in a curve to the psalistoma, which is tipped with two or three small sharp teeth; it has no synaphipod, and the apophysis is matted over the outer surface with fine cilia.

The first pair of siagnopoda is thin-lobed; the inner and central lobes are broad, foliaceous, and fringed with hairs, and the outer short, curved, and tipped with one or two long hairs.

The second pair (*f*) of siagnopoda is bilobed; the inner lobe is broad and long-quadrate, it is biarticulate, and has the inner margin of both joints closely ciliated; the outer lobe projects anteriorly nearly as far in advance as the distal extremity of the inner and is produced posteriorly to an obliquely truncate extremity that supports a large number of very long free hairs. The rest of the margin is fringed with shorter hairs, those on the posterior portion are the shortest, and those on the anterior distal margin the longest; the posterior portion extends as far back in the branchial chamber as the second pair of pereiopoda, and sends the long hairs as far as the posterior extremity of that chamber.

The third pair (*g*) is bilobed; the inner lobe is broad, matted with hairs on the inner surface, and has the margin fringed with long closely packed curved hairs; from the posterior margin of this lobe a uniarticulate process projects that I take to be the rudimentary homologue of the true appendage, the outer distal angle of which is produced to a tooth-like point, and the inner surmounted by a small fasciculus of hairs. The outer lobe is quadrate, and the distal and inner angle is produced into a long flat process with parallel margins and a rounded extremity; the entire margins are fringed with hairs, of which those at the base are the shortest, whence they gradually increase in length until they reach the distal process, where they attain an extreme length; on the inner margin between the two lobes the hairs are more numerous and form a double mat-like fringe.

The first pair of gnathopoda (*h*) is subpediform; the coxal joint supports a well-developed podobranchia and a fasciculus of hairs; the basis is long and supports a two-jointed ecphysis, of which the distal joint is multiarticulate; the ischium is short, and the meros still shorter; the carpos is produced above the propodos and has the distal inner angle fringed with hairs; the propodos is broad, short, lunate, and reflexed against the meros, ischium and basis, the anterior edge is concave and thickly fringed with stiff hairs, amongst which the short, broad and marginal dactylos is immersed.

The second pair of gnathopoda (*i*) is four-jointed and pediform; the coxa or first joint carries a moderately developed podobranchial plume and a tubercle capped with long hairs; the second joint is long, curved, and carries a long two-jointed ecphysis, which

is connected with the basis near the basisal articulation; the ischium is long but not so long as the preceding joint, and is furnished with a series of rows of hairs on the inner surface; the meros, which forms the distal joint, is about half the length of the ischium and is longitudinally hollowed, or spoon-shaped, having the margins fringed with hairs.

The first two pairs of pereiopoda (*k*) are similar in form, chelate, short, and somewhat feeble. The coxa carries a fasciculus of long hairs placed on a prominent tubercle, and the slender rudiment of a mastigobranchial plate, fringed on the lower or convex margin with long hairs; the basis is short and carries no ecphysis; the ischium and meros are subequally long and overlap each other obliquely, the upper margins of both being fringed with stout hairs, and the lower and outer surface with soft hairs; the carpos is short, lunate, and produced to an angle on the upper surface. The propodos is subcylindrical, slightly curved, and has the anterior extremity lanceolate in form and flattened on the inner side, and the margins fringed with long, finely ciliated hairs; it articulates near its centre with the lower angle of the carpos, and is produced nearly as much behind the articulation as in front of it, and it also articulates with the dactylos at the posterior extremity, the base of the dactylos being nearly as broad as the diameter of the propodos. The dactylos is formed on the same plan and is placed in an antagonistic position, so that these two joints together form a chela of a peculiar and unusual form. The second pair resembles the first and is of similar proportions. The third pair is simple and much larger than the preceding; the coxa is as broad as long, and supports a rudimentary mastigobranchia similar to the preceding, but larger; the basis is short, and the ischium and meros are fused together and very greatly enlarged, being nearly as long as the carapace; it is covered with coarse tubercles that have much the appearance of pointed processes rubbed down by wear. The carpos is curved on the upper surface and waved on the lower, being narrowest near the meros; near the centre of the inner and lower side is a prominent tooth standing on a slight elevation; the propodos is broadest at the carpal extremity, and gradually narrows to the dactyloid articulation; the dactylos is short and of smaller diameter than the distal extremity of the propodos. The carpos and propodos are covered with coarse teeth or pointed tubercles, smaller than the largest of those on the meros, among which, particularly on the lower surface, are some short stiff hairs. The fourth pair is much smaller than the third, but developed like it, and the fifth pair also differs only in being smaller and in having no rudiment of a mastigobranchial appendage.

The first pair of pleopoda (Pl. CXIX. fig. 1*p*) is biramose, the branches being subequal, are in the male short and deflected from each other; the inner branch is rigid and terminates in a blunt point, the outer side is fringed with a closely packed row of short, reversely curved, hook-like spines, that are continuous to the base of the branch, while

near the apex on the inner margin is a short and robust stylamblys, tipped with cincinnuli. The outer branch is also short, rigid, and fringed with hairs that are planted in lateral rows. The second pair of pleopoda (fig. 1*q*) is subequal; the outer branch is long, ovate, foliaceous, and fringed with hairs, and the inner is nearly as long but having the margin straight, and the basal portion supports a transversely broad disc-like process that is matted with curved spines on the distal surface, from the centre of which there springs a short but well-developed stylamblys tipped with cincinnuli. The third pair of pleopoda is long, ovate, foliaceous, and fringed with hairs; on the distal margin of the inner branch there is a short stylamblys. The fourth and fifth pairs resemble the third, but are a little shorter; the stylamblydes in our specimen have the cincinnuli on either side hooked together, thus holding the two appendages in contact, and demonstrating their use. The sixth pair of pleopoda (Pl. CXVIII. *v*, *v*), which helps to form the rhipidura, has the basal joint short, with two clefts, one upon the outer side into which the outer ramus falls, the other on the upper surface in which the inner ramus rests when the tail-fan is extended. The outer margin of the external ramus is robust and rigid for a considerable distance, where it terminates in a small tooth and an obliquely transverse row of regular bead-like points, marking the line of the diæresis, which is separated or free for one-third of its extent. The distal extremity of both the branches is rounded and broader than their base. On the posterior ventral surface of the somite between the basal joints of the pleopoda there is a small longitudinally compressed tooth, and on each side an elevated lunate process, separated from the outer wall by a cleft and acting as a rest or support to the inward pressure of the rhipidura.

There are eight pairs of branchial plumes, six of which are pleurobranchial and two podobranchial, as shown in the following table :—

Pleurobranchiæ,	...	1	1	1	1	1	1
Arthrobranchiæ,	...	...	...	...	...	...	...
Podobranchiæ,	1	1	...	...	...	...	...
Mastigobranchiæ,	...	1	1	1	1	1	...
	h	i	k	l	m	n	o

Observations.—A. Milne-Edwards considers this species to be a variety of *Atya scabra*, Leach, and says that "it appears to differ only in the feet, which are slightly grooved, by the median piece of the tail (telson) presenting a more marked triangular depression, and by the antennæ not being more than half the length of the body."

The original drawing, which is now in my possession, of Dr. Leach's figure in the Zoological Miscellany, shows that in *Atya scabra* the second antennæ are not so long as the carapace, whereas in our specimen they reach to the sixth somite of the pleon, or more than three-fourths the length of the animal, but I cannot discover any grooving along the legs to correspond with Newport's description.

The Challenger specimen was found at San Iago, Cape Verde Islands, and the type in the British Museum, being that from which Mr. Newport's description was taken, was obtained at San Nicolao, in the same group.

Atya serrata, n. sp. (Pl. CXIX. fig. 2).

Carapace less than one-third the length of the animal, anteriorly produced to a rostrum that is about one-third the length of the carapace, slightly elevated to a central carina on the upper surface, and produced on the under side to a ridge, the anterior margin of which is serrate with three small teeth.

The rest of the animal so closely corresponds with the specimens of *Atya* (*Atyoida*) *bisulcata*, Randall, from Honolulu, that it is difficult to distinguish them by any other feature.

Length, entire,	. . . . .	37	mm. (1·4 in.).
,, of carapace,	. . . . .	10	,,
,, of rostrum,	. . . . .	3	,,
,, of pleon,	. . . . .	27	,,
,, of first three somites of pleon,	. . .	4	,,
,, of fourth somite of pleon,	. . . .	3·5	,,
,, of fifth somite of pleon,	. . . .	3	,,
,, of sixth somite of pleon,	. . . .	4	,,
,, of telson,	. . . . .	5·5	,,
,, of peduncle of first antenna,	. . .	5·5	,,
,, of scaphocerite,	. . . . .	5·5	,,
,, of first pereiopod,	. . . . .	8	,,
,, of second pereiopod,	. . . .	9	,,
,, of third pereiopod,	. . . .	13	,,
,, of fourth pereiopod,	. . . .	13	,,

Habitat.—Valley of San Antonio, San Iago, Cape Verde Islands; from a fresh-water stream.

This species, when placed side by side with the Honolulu specimens that I consider to belong to *Atya bisulcata* (Randall), exhibits only slight and unimportant differences.

The largest specimen from the Cape Verde Islands is nearly one-fourth longer than the largest from Honolulu. The rostrum of the Cape Verde specimens is a little longer in proportion than in those from Honolulu, it being three-tenths the length of the carapace as compared with two-tenths in the Honolulu specimens. In *Atya bisulcata* the dorsal median line of the rostrum is elevated as it is in *Atya serrata*, but the corresponding median line on the under surface is smooth and receding, whereas in *Atya serrata* it is deeper, laterally compressed, and furnished with three or four small, sharply defined teeth; this is the most distinguishing feature, and the one from which the species takes its name.

The ophthalmopoda are somewhat larger than in *Atya bisulcata*, reaching nearly to the extremity of the rostrum, and have the ophthalmus not broader than the peduncle.

The first pair of antennæ has the first joint of the peduncle subequal with the rostrum and the distal margin fringed with small, equal comb-like spinules; the stylocerite on the outer margin is equal in length with the rostrum and subequal with that of the first joint of the antenna. The second and third joints resemble those of *Atya bisulcata*, and the under surface of the third is anteriorly fringed with hairs, but not so densely as in the former species. The flagella in the type are broken, but a comparison with another specimen makes it probable that they are a little shorter than those of *Atya bisulcata*.

The second pair of antennæ is about half the length of the animal, and nearly corresponds in form with that of *Atya bisulcata*. The scaphocerite exhibits a corresponding diæresis, originating at the outer margin in front of the external tooth, and passing transversely across the squamous portion in a curved direction.

I have not disturbed the oral appendages in this species since there are only two specimens, but I assume that they differ in as small a degree from those of the typical species as do the other parts which have been fully examined.

The first two pairs of pereiopoda appear to correspond specifically with those of *Atya bisulcata*. The third pair seems to differ by the presence of a small tooth on the under and outer side of the meros, and another at the anterior and lower angle of the carpos, and the unguis of the dactylos is a more decided feature.

The fourth and fifth pairs of pereiopoda, so far as preserved, resemble the third, but are slightly more slender and the armature is more feeble.[1]

The first and succeeding pairs of pleopoda offer no distinctive feature, so far as can be determined without dismemberment, from those of other species, and the telson and lateral plates of the rhipidura likewise correspond.

Atya bisulcata (Randall) (Pl. CXX.).

Atyoida bisulcata, Randall, Journ. Acad. Nat. Sci. Philad., vol. viii. p. 140, pl. v. fig. 5.
„ „ Dana, U.S. Explor. Exped., Crust., p. 540, pl. xxxiv. fig. 1.
„ „ Stimpson, Proc. Acad. Nat. Sci. Philad., January 1860, p. 97.

The dorsal surface of the carapace is smooth and not carinated until near the rostrum, which is elevated in the median line and produced anteriorly to beyond the extremity of the first joint of the first pair of antennæ; it is a little longer in the male than in the female. On each side of the central carina there is a small channel that dies out just behind the orbital margin. The anterior margin of the carapace is

[1] The three posterior pairs of pereiopoda are more robust than they are represented in the figure of the whole animal (fig. 2), and correspond more nearly with the detached figure (fig. 2*m*) on the same Plate.

furnished with an antennal tooth that corresponds with the external canthus of the orbit, and with another situated above the fronto-lateral angle.

The pleon is dorsally smooth and has the sixth somite but little longer than the preceding, and terminates in a telson that is about a third shorter than the lateral plates of the rhipidura.

The ophthalmopoda are short, the ophthalmus being orbicular and scarcely of greater diameter than the stalk.

The first pair of antennæ (*b*) has the first joint of the peduncle excavate on the upper surface, and is distally fringed with a double row of short stiff spinules, regular in their length and comb-like in appearance, while on the outer side a sharp-pointed stylocerite projects quite equal to the length of the joint. The second and third joints are cylindrical, furnished with a mat of hairs on the lower surface, and terminate in two long, slender, multiarticulate flagella, the outer and upper of which is stouter near the base and divides into two rami at a short distance from its base, the inner of which is truncate; whereas the inner and lower flagellum is about two-thirds the length of the outer, and gradually tapers from the base to the apical extremity.

The second pair of antennæ (*c*) carries a slender flagellum that is as long as the animal, and a broad ovate scaphocerite, armed on the outer margin, half-way between the base and the apex, with a sharp tooth, from which a line of division, like the diæresis of the outer plates of the rhipidura, crosses the plate transversely in a curved line; a long, tapering, and slightly curved phymacerite springs from the inner surface of the coxal joint.

The mandibles (*d*) are without a synaphipod, but possess a molar process and distinct psalistoma, the latter being dentated with three sharp denticles, and the former obliquely truncate and furnished with minute spinules and denticles.

The first pair of siagnopoda (*e*) is small, feeble, foliaceous, and three-branched; the outer branch is short, ovate, and tipped with a couple of long hairs; the middle branch is broader at the distal extremity than at the base, and is fringed at the distal inner margin with short spinules, and the inner branch is short and circular.

The second pair of siagnopoda (*f*) carries a long foliaceous process, produced to a point and reaching posteriorly far into the branchial chamber; it is furnished with long hairs that sweep the surface of the branchial plumes to their furthest extremity.

The third pair of siagnopoda (*g*) is formed as in *Atya sulcatipes*, but has the digital process somewhat more slender.

The first pair of gnathopoda (*h*) resembles that of *Atya sulcatipes*, and like it the rudimentary mastigobranchial plate does not support a branchial plume, but is fringed with a series of flat pointed spinules, and the basecphysis is proportionally more slender.

The second pair of gnathopoda (*i*) is pediform, and differs from that in *Atya sulcatipes* in being more slender and having the terminal joint longer in proportion.

The anterior two pairs of pereiopoda resemble each other in form and nearly correspond in size, they differ from those of *Atya sulcatipes* in having the carpos more cup-shaped, for the reception of the posterior or carpal extremity of the propodos (*k*). The posterior three pairs are subequal in size and form, they are slender and have the margins subparallel and fringed with small spines, particularly on the posterior margin of the three distal joints.

	Male.	Female.
Length, entire,	23 mm. (0·9 in.).	35 mm. (1·3 in.).
„ of carapace,	7 „	10 „
„ of rostrum,	1 „	2 „
„ of pleon,	16 „	25 „
„ of first, second, third, fourth, and fifth somites of pleon,	2 „	3 „
„ of sixth somite of pleon,	3 „	3·5 „
„ of telson,	4 „	5 „
„ of peduncle of first antenna,	4 „	5 „
„ of scaphocerite,	4 „	5 „
„ of first and second pereiopoda,	6 „	9 „
„ of third pereiopod,	10 „	13 „
„ of fourth pereiopod,	10 „	13 „
„ of fifth pereiopod,	10 „	13 „

Habitat.—Honolulu. One hundred specimens, of which eleven were gravid with numerous long-ovate ova; the largest specimen was 35 mm. and the smallest 23 mm., which was also the size of the males, which differ in little else from the females.

Sandwich Islands, Randall, Dana, Hilgendorf, and Stimpson; Seychelles, Hoffman.

Caridina, Milne-Edwards.

Caridina, Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 362.

The carapace, according to Milne-Edwards, presents no special feature; it is anteriorly produced to a flattened tenuous rostrum ("rostre lamelleux"), of which the length varies in different species.

The ophthalmopoda are prominent.

The first pair of antennæ is very long and terminates in two flagella, one of which is stout at the base.

The second pair of antennæ resembles that of *Palæmon*.

The second pair of gnathopoda is long, slender, and pediform.

The anterior two pairs of pereiopoda are didactyle. The first pair is very short, and possesses a very remarkable character, the carpos being triangular, and anteriorly produced in a concave border, and receives the posterior margin of the propodos, which is attached to its inferior angle; the propodos is short, the fingers being deeply hollowed

and terminating in a brush of ciliated hairs. The second pair of pereiopoda is longer and more slender than the first, the carpos being narrow and cylindrical, while the propodos and dactylos resemble those of the first pair. The posterior three pairs are slender and nearly of the same length and proportion.

The pleon resembles that of *Palæmon*.

Observations.—There is but one specimen of this genus in the Challenger collection, and since it was preserved in the same bottle with *Atya sulcatipes* and two specimens of *Atya serrata*, it seems almost certain that all these specimens were taken from the same river in the Cape Verde Islands, for I assume from the known carefulness of the collectors that they would have otherwise been separated and labelled accordingly. My first opinion was that the three were successive stages in the growth of one species. But in the examination of a large number of specimens from Honolulu of the closely allied form *Atya* (*Atyoida*) *bisulcata* I found a few with ova, and in some of these the embryo so far advanced that by extracting it from the egg I was enabled to determine that the brephalos is a Zoea (p. 692).

This at all events settles that the *Atyoida* form could not be a stage in the growth of *Atya*, and the fact that several species of *Caridina* have been found in various localities, in few of which *Atya* has been recorded, makes one hesitate with our present experience to determine the true relationship, although it is clear that *Atya* must pass through some such form as *Caridina* before it can attain its full development.

The form which Milne-Edwards, under the name of *Caridina typus*, has described as a genus distinct from *Atya*, chiefly differs both from that genus and from *Atyoida*, according to its author, in the third pair of pereiopoda being slender and the second pair having the carpos of the ordinary form.

The portion of a specimen figured on Pl. CXIX. fig. 3, appears to me to belong to the same species as that which Milne-Edwards has figured and described under the above name, and it is not improbable that Milne-Edwards' specimen may have come from the same locality.

The fragment consists of the pereion with its appendages, and those that belong to the mouth. It is part of an animal still young, but approaching the adult condition, a circumstance that inclined me to believe it to be an immature stage in the development of *Atya*, with which it was found associated. Milne-Edwards' specimen is only ten lines long, and this is probably about the length of the animal to which our fragment belonged.

The difficulty depends on the singular variation between the form of the carpos in the first two pairs of pereiopoda. In the adult *Atya* the carpos of both pairs is short, robust and lunate, but in *Caridina* the carpos in the first pair corresponds with that of the adult *Atya*, while in the second pair it is long, slender and cylindrical.

But since appendages which are more or less peculiar in feature in the adult stage pass through forms of less normal character, I was strongly inclined to believe that *Caridina* was only a young stage of *Atya*. The locality of Milne-Edwards' *Caridina typus* is unknown, and it is not said whether it was found in fresh or salt water. Its association with the genus *Atya* from the Cape Verde Islands is significant, and its juvenile condition is suggestive of a relationship that can only be determined by a demonstration of the adult form of *Caridina*, or by more complete knowledge of the development of *Atya*.

Geographical Distribution.—Our specimen of *Caridina typus* was taken at San Iago, Cape Verde Islands, associated with *Atya sulcatipes* and *Atya* (*Atyoida*) *serrata*. It was probably here that Milne-Edwards' typical specimen was obtained. *Caridina longirostris* is stated by Milne-Edwards to have been found by Roux in the rivière de la Macta, near Oran. Stimpson records *Caridina grandirostris*, *Caridina brevirostris*, and *Caridina exilirostris* from the Island of Loo-Choo; *Caridina leucostica* from a river near the town of Simoda in Japan; *Caridina multidentata* and *Caridina acuminata* from the mountain streams in the island of Bonin, and *Caridina serrata* from rivulets in the Island of Hong Kong. *Caridina nilotica*, Roux, is recorded from Mozambique by Hilgendorf.[1]

Caridina typus, Milne-Edwards (Pl. CXIX. fig. 3).

Caridina typus, Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 363, pl. xxv. *bis*, figs. 4, 5.

"Rostrum sharp pointed, straight, of moderate proportion, not reaching the extremity of the second joint of the first pair of antennæ, and armed on the under surface with three little teeth. First pair of pereiopoda not so long as the second pair of gnathopoda. Extremity of the chela fringed with numerous hairs.

"Length about 10 lines.

"*Habitat?*"

Such is the account Milne-Edwards gives of a small animal similar to that obtained by the Challenger from a rivulet in the valley of San Antonio, San Iago, Cape Verde Islands, and which corresponds closely with his description and illustration in every detail, excepting that in our damaged specimen the first pair of pereiopoda is longer than the second pair of gnathopoda. In our specimen the pereion is preserved, including all the appendages, from the mandibles to the posterior pair of pereiopoda, but separated from the carapace and pleon, which were also found in the same bottle.

The mandibles and the other oral appendages, so far as they have been observed, correspond in form with those of *Atya*, which is found in the same locality.

The second pair of gnathopoda has the terminal joint shorter than the penultimate,

[1] *Monatsber. d. k. preuss. Akad. d. Wiss. Berlin*, p. 838, 1878.

and is armed with numerous spinules near the distal extremity; a prominent one stands at the apex, while at the base there is a series of several transverse rows of short curved hairs, and on the penultimate joint another series of shorter and more distant rows of hairs. Attached to the basisal joint is an ecphysis that reaches beyond the meral articulation of the carpal joint.

The first pair of pereiopoda is short and stout, it has the carpos broad, short, and lunate, in the hollow of which the propodos rests when extended; the propodos has the inferior distal or polliciform angle stout and tipped with a brush of hairs, while the dactylos is short, curved, and thick, but narrower than the pollex, and like it distally furnished with a brush of hairs that are ciliated at their extremity and do not equal the joint in length. The second pair of pereiopoda is longer than the first; the carpos and preceding joints are cylindrical and slender, the carpos being long and not distally lunate. The chela is formed as in *Atya*, but the propodos is more robust at the base, and the pollex and dactylos are tipped with a shorter brush of hairs. The third pair of pereiopoda is slender, slightly longer than the second, and slightly more robust, particularly at the meral joint, which is armed on the posterior margin with three strong spinules. The carpos is long, with the margins subparallel, the posterior margin being armed with four small spinules and a fifth and larger one on the side; the upper distal angle projects over the propodal articulation; the propodos is nearly twice the length of the carpos, cylindrical, and armed on the posterior surface with a double row of spinules that increase in size as they approach the dactyloid articulation; the dactylos is slightly curved, armed with four or five spinules on the posterior margin, and terminates in a strong unguis.

The length of the living specimen, judging by what is preserved of it, must have been about 20 mm., or about the same length as the specimen recorded by Milne-Edwards.

It is desirable to notice that Milne-Edwards, in his description of *Caridina typus*, says that the rostrum is "aigu, médiocre, ... et armé en dessous de trois petites dents." The carapace, with the rostrum, has been preserved in our specimen, but separated from the rest of the animal, and it shows the three little teeth corresponding with Milne-Edwards' description as well as with the description of *Atya serrata* from the Cape Verde Islands.

Pontonia, Latreille.

Pontonia, Latreille, Règne Anim. de Cuvier, ed. 2, tom. iv. p. 96.
„ Roux, Mem. class. crust. Salicoques, p. 26.
„ Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 358.
„ de Haan, in Siebold's Fauna Japonica, Crust., p. 75, tab. O.
„ Dana, U.S. Explor. Exped., Crust., p. 570.
Conchodytes, Peters, Bericht. d. k. preuss. Akad. d. Wiss. Berlin, p. 588, 1852.

The species on which this genus was founded by Latreille, and confirmed by Milne-Edwards, was that which was described by Risso as *Alpheus tyrrhenus*. According to

Milne-Edwards it has the carapace short and rounded (renflée), anteriorly armed with a short, robust, and depressed rostrum.

The ophthalmopoda are cylindrical, prominent and very mobile.

The first pair of antennæ is very short and nearly similar to that of *Palæmon*. The first joint of the peduncle is broad and lamellose on the outer side; the two succeeding joints are small, cylindrical, and terminate in two flagella, one of which is bifid at the extremity.

The second pair of antennæ is inserted below and outside the first pair and carries a broad and short scaphocerite.

The second pair of gnathopoda (pates-mâchoires externes), according to Milne-Edwards, is small and narrow in its entire length.

The first two pairs of pereiopoda[1] are didactyle. The first pair is subequal, slender, and terminates in a well-formed but very small chela. Those of the second pair on the contrary are very unequal, one being extremely large and the other small, especially among the females. Sometimes the right and sometimes the left is the larger in different specimens of the same species. The three succeeding pairs of pereiopoda are of medium size, monodactyle, and terminate in a nearly rudimentary dactylos.

The pleon is broad, especially in the females, and presents a conformation analogous to that which exists in the genus *Palæmon*.

It only remains to be noted that the telson carries no spine on the dorsal surface.

The branchiæ are well developed; there are only five on each side, those belonging to the oral appendages being rudimentary, and the somites of the pereion carry only single pairs.

Dana's description corresponds with that of Milne-Edwards, excepting that he says the outer maxillipedes (second pair of gnathopoda) are suboperculiform.

There is but one specimen of this genus in the collection and that is much damaged, all the pereiopoda excepting the greater chela being lost, and the posterior somites, pleon, and rhipidura are wanting.

Observations.—This genus corresponds closely with *Typton*, Costa, but there are several points of difference. The dorsal surface is depressed and flattened, instead of being elevated and arcuate. The rostrum is dorsally flat, instead of being laterally compressed. There is no ocellus on the posterior margin of the ophthalmus as there is in *Typton*. The first pair of antennæ has the inner flagellum bifurcate at the extremity, whereas it is single in *Typton;* in both the stylocerite is reduced to a rudimentary condition. The second pair of antennæ in both genera is small and feeble; in *Pontonia* the scaphocerite is well developed but short and strong, whereas in *Typton* it is reduced to a rudimentary condition, forming a small membranous scale. The mandibles in

[1] In Milne-Edwards' description the paragraph runs "Les pates des quatre premières paires sont didactyles," which from the context is evidently a misprint for "deux paires."

both genera correspond in form and the oral appendages generally resemble each other. In *Typton* the branchiæ, however, number six or seven on each side, namely, a pair of pleurobranchiæ corresponding with each pair of pereiopoda, and a pair of arthrobranchiæ attached to the membranous articulation of the second pair of gnathopoda.

Geographical Distribution.—Species of this genus have been found in the Mediterranean by Roux, Costa, Risso, Verany, Lucas, Guérin-Méneville, Heller, and Milne-Edwards. Roux[1] records *Pontonia parasitica* from the coast of Morea, and like *Pontonia tyrrhena* it was found lodged between the valves of a *Pinna* after the manner of *Pinnotheres* in the oyster; and it is probable that it is to this Crustacean that Aristotle refers when he says a little Squilla as well as a little crab is found in the shell of a Mollusc. Species, according to Milne-Edwards, have been taken in the Asiatic Seas by Dussumier, off the coast of New Ireland and Vanicoso by Quoy and Gaimard, and at Ceylon by Reynaud. Both Dana and Stimpson found species resident in the shell of *Tridacna*, the former off Tutuilla, one of the Samoan or Navigator group of islands in the Pacific, and the latter off the Island of Bonin. The species described in this collection was taken from the pearl oyster (*Meleagrina ?*) in Torres Strait.

Pontonia meleagrinæ (Peters) (Pl. CXXIV. figs. 1, 2).

Conchodytes meleagrinæ, Peters, Bericht. d. k. preuss. Akad. d. Wiss. Berlin, p. 594, 1852.
„ „ Hilgendorf, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 836, 1878.

Carapace more than one-half the length of the animal; dorsally broad and flattened, being wider across the cardiac region than anteriorly or posteriorly. Rostrum dorsally flattened, anteriorly depressed, inferiorly slightly compressed and produced. Frontal margin deeply excavate to form an orbit, the outer canthus of which is defined by a point. There is no tooth corresponding with the first or second antennæ.

Somites of pleon short and dorsally flattened; the anterior is the broadest and the posterior the narrowest. The fifth somite and telson are wanting.

Ophthalmopoda short, being about half the length of the rostrum.

First pair of antennæ having the peduncle equal in length with the rostrum and the flagella short, or about half the length of the peduncle. Upper and outer flagellum stout, inner slender.

Second pair of antennæ having the peduncle longer than the scaphocerite, which is broad, sharp pointed, and lanceolate in form.

Posterior to the oral organs all the appendages of the pereion, excepting the second right pereiopod, are broken off in our specimen.

Gnathopoda subpediform, having the terminal joints broad, squamous, and reflexed.

[1] *Loc. cit.*

First pair of pereiopoda having the propodos on the right side excessively developed, being as long as the animal and nearly as broad; the pollex is shorter than the dactylos and bicuspidate; the dactylos has the extremity hooked and the inner margin bears one cusp.

Pleopoda biramose, and furnished with a long and slender stylamblys.

The posterior somite and telson are broken off.

Length, entire,	18 mm. (0·7 in.).
„ of carapace,	7 „
„ of rostrum,	3 „
„ of pleon,	11 „
„ of large chela,	16 „

Habitat.—The label on the bottle containing the specimen says "Crustacean found in Pearl oyster, Torres Straits, presented at Sydney, June 1874." It was, therefore, not dredged by the Challenger, which did not arrive at Torres Strait until the following September.

Ibo, on the south-east coast of Africa; between the folds of the mantle of *Meleagrina margaritifera*, Lam. (Peters).

The specimen, unfortunately, is damaged, but enough is preserved to show its true character. The body of the animal is dorsally slightly arcuate from the frontal region to the fifth somite of the pleon, which is bent downwards, and, judging from the character of the curve, the sixth somite and rhipidura, in the living animal, are compressed beneath it. The carapace is dorsally depressed and broadest over the genital and cardiac regions; anteriorly it is produced to a rostrum that continues the slight dorsal curve and bends downwards at the anterior extremity; it is about one-fourth the length of the carapace, sharp at the point, and produced on the under side to a narrow or compressed median ridge. From the sides of the rostrum the margin diverges to form the orbits, which are deeply excavate, almost to the extent of the ophthalmopoda, and defined at the outer angle by a sharp point between the orbit and the notch excavated to receive the second pair of antennæ, whence the carapace is deflected abruptly beneath the peduncle and forwards beyond the base of the scaphocerite, traversing in this incurved position the entire length of the carapace, the posterior portion of which is membranous and flexible.

The pleon has the first somite as broad as the carapace, over the postero-lateral border of which it projects; each somite gradually decreases in breadth and depth posteriorly. The sixth somite and the rhipidura are wanting, but from appearances it would seem that the posterior somite and the telson curve beneath the pleon, as represented by the dotted line on Pl. CXXIV. fig. 1.

The ophthalmopoda reach but little beyond the orbit, and are cylindrical and nearly as broad as long; the ophthalmus is wanting in colour.

The first pair of antennæ (fig. 1*b*) has the peduncle subequal in length with the rostrum, against the under side of which it lies; the first joint is broad and carries an obtusely-pointed, squamous stylocerite on the outer side; the other two joints are cylindrical and support at the extremity two flagella, one stout and the other slender, the former being bifurcated at the extremity into two short rami; neither is more than half the length of the peduncle.

The second pair of antennæ (fig. 1*c*) lies on the outer side of the first and is enclosed within a fold of the carapace formed by the lateral margin being bent acutely under it, the frontal angle, extending forwards beyond the articulation of the scaphocerite, is thickened to a strong ridge that precludes its downward movement. The scaphocerite is short and disc-like, being nearly as broad as long, and has the outer margin distally armed with a short point or tooth.

The mandible (fig. 1*d*) is divided into a molar process and a pointed psalistoma, but possesses no synaphipod.

The first pair of siagnopoda (fig. 1*e*) is three-branched; the two inner branches are broad, flat, and disc-like, and have the inner margin thickly matted with short, stiff hairs; the third or outer branch is short, cylindrical, and truncate. The second pair (fig. 1*f*) is likewise three-branched; the inner branch is long, narrow, pointed, and has the inner margin thickly fringed with long hairs; the middle branch is short, narrow, cylindrical, and smooth; the outer or third forms a large mastigobranchial plate that projects anteriorly beyond the extremity of the other two branches and posteriorly into a rounded margin; it is fringed anteriorly and posteriorly with hairs; those on the rounded posterior portion tending to curve anteriorly; the longest hairs are at the posterior extremity, the next longest at the anterior, and the shortest, which are almost obsolete, at the broadest diameter of the plate.

The third pair of siagnopoda (fig. 1*g*) consists of four branches or divisions; the inner branch is broad and long and has the inner margin fringed with an even row of short hairs; the middle branch is short, narrow, cylindrical and smooth; and the outer is broad at the base and smooth at the margins, and from its inner margin near the apex there arises a long, narrow, compressed, ribbon-like process that is distally tipped with short hairs, and on the outer surface near the base is a small bilobed mastigobranchia.

The first pair of gnathopoda (fig. 1*h*) is six-jointed; the coxa is short, robust, and supports a broad, short, and square-shaped mastigobranchia; the basis is long, has the inner and outer margins parallel, and carries a two-jointed ecphysis, of which the first joint is the more robust; the third joint or ischium is short and subcylindrical, as is also the meros, which anteriorly projects beyond the base of the next joint, and represents the meros and carpos combined; the terminal two joints are reflexed against the inner margin of the meros and together form a semilunar disc-like plate, the dactylos forming

a narrow plate along the inner margin of the propodos, and is studded with short, stiff hairs of equal length.

The second pair of gnathopoda (fig. 1*i*) is larger than the first; the coxal joint is broad; the basisal joint is short and broad, and has the inner margin fringed with fine hairs, while the outer supports a long, slender, compressed ecphysis, distally fringed with small hairs; the ischium is broad at the base, slightly curved, and narrows distally, forming a long and tapering operculiform plate; the next succeeding joint is short and broad, and articulated with the preceding obliquely across its longitudinal plane, and the terminal joint is sharp pointed, and both are thickly fringed with hairs on the inner margin.

The first pair of pereiopoda is wanting in our unique specimen, and so are all the others excepting the right one of the second pair. In this the carpos is triangulate; the propodos is about equal to the entire length of the animal; it is slightly curved in a longitudinal direction, broader near the base than at the distal extremity, the cross-section is ovate, being rather more distended on the outer than on the inner side; the distal extremity is produced to a pollex that has two cusps on the inner surface and is slightly curved at the apex, where it corresponds with that of the dactylos; the dactylos is short, deep, arcuate on the outer margin and unicuspidate on the inner, corresponding with the depression between the two cusps on the pollex.

This chela is therefore, in proportion to the size of the animal, a very weighty appendage, and, as in all Crustacea where the organ is so monstrously developed, it is useless in its adaptation to supply the mouth, and, therefore, is probably of value as an anchorage, by its great weight enabling the animal to hold its position more easily and with less muscular effort.

The pleopoda are short and biramose, the inner branch being furnished with a stylamblys. The rhipidura is wanting.

Observations.—The specimen does not appear to have been obtained by the Challenger at any of the recorded stations, and it might easily be taken for that described by Professor Milne-Edwards under the name of *Pontonie enflée*,[1] whose description I translate as follows:—

"No spine near the base of the external antennæ. Carapace having the lateral margins very much inflexed; rostrum reaching nearly to the extremity of the scaphocerite. Second pair of pereiopoda very large and nearly cylindrical. Length, one inch." But, since the name applied by Milne-Edwards is suggestive of an inflated or swollen appearance, I have hesitated to believe this to be the same species, the more especially because the author says[2] that a short carapace is characteristic of the species of this genus, and this coincides with the figure given by Dana, whereas in our species the body is by no means inflated, although the chela is a large and weighty appendage; the pleon instead of being wide gradually narrows posteriorly from the first somite.

[1] Hist. Nat. Crust., tom. ii. p. 360.

[2] *Loc. cit.*, p. 358.

Milne-Edwards describes the genus as having the second pair of gnathopoda small in size and very narrow. Dana describes it as being suboperculiform, which corresponds more nearly with the condition in our species.

Milne-Edwards also says that there are five well-developed branchial plumes on each side, and that those attached to the oral appendages are rudimentary. Dana says that in *Pontonia tyrrhena* there are but four branchiæ on either side of the pereion, and that there are none attached to the fifth pair of pereiopoda.

In our specimen there are four pairs of pleurobranchiæ, that belonging to the posterior somite being wanting.

This description may be reconciled with that of Milne-Edwards, since it is evident that what he describes as a branchia attached to the oral appendage, and therefore rudimentary, is what I have described as a mastigobranchial appendage connected with the posterior pair of siagnopoda (or maxillipede).

The branchial apparatus in this species consists of four pleurobranchial plumes on each side and may be tabulated as follows :—

Pleurobranchiæ,	.	.	.	...	...	1	1	1	1	...
Arthrobranchiæ,	.	.	.	...	...	...	...	...	...	...
Podobranchiæ,	.	.	.	...	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	...	...	...	...	...	...	...
				h	i	k	l	m	n	o

The original description of Dr. W. Peters was communicated to the Academy of Berlin February 18, 1851, but so far as I can ascertain was not published until 1852, the same year that Dana published his description of *Pontonia tridacnæ*, which is probably the same species, and I am inclined to think from the description that *Conchodytes meleagrinæ*, Peters, taken at Ibo on the Mozambique coast, is probably the same species as the Challenger specimen, *Pontonia meleagrinæ*, from Torres Strait.

Our specific name was in type before I was aware of Peters' or Hilgendorf's memoirs. Peters' specimen was a female, 33 mm. long, and like ours was probably found in the pearl-oyster, hence the coincidence of its specific name.

Family Palæmonidæ.

Carapace dorsally rounded and laterally compressed. Rostrum long, laterally compressed, and generally armed with teeth. Pleon laterally compressed. Telson long and gradually narrowing to a truncated extremity. Ophthalmopoda well developed and pyriform. Antennæ long and slender; first pair having the first joint of the peduncle hollowed on the upper surface, carrying a well-developed stylocerite on the outer side, and terminating in two flagella, of which one is frequently branched; second pair furnished with a long and narrow foliaceous scaphocerite, the outer margin of which is

rigid and armed with a small tooth. Mandible furnished with a molar process, psalistoma, and synaphipod. Second pair of gnathopoda pediform. First and second pairs of pereiopoda chelate. Pleopoda biramose. Rhipidura well developed.

Caricyphus,[1] n. gen.

Carapace less than one-third the length of the animal, dorsally smooth and anteriorly produced to a small, sharp-pointed rostrum. The fronto-lateral angle is produced to a small tooth.

The pleon is long, the first three somites are as deep as the carapace and the succeeding ones are narrow and slender. The third somite is large, dorsally produced in the middle, and abruptly descends to the posterior margin, where it articulates with the fourth somite at a right angle with the preceding somites.

The telson is long and tapering.

The ophthalmopoda are well developed.

The first pair of antennæ is biflagellate.

The second pair of antennæ carries a large scaphocerite and a long flagellum.

The mandibles are without a synaphipod.

The first pair of gnathopoda is subpediform.

The second pair is pediform, six-jointed, and carries a long uniarticulate basecphysis.

The first pair of pereiopoda is chelate and carries a long, flat, uniarticulate basecphysis. The second pair is a little larger than the first, chelate, and supports a similar basecphysis. The third pair is simple, slender, subequal in length, and also bears a similar basecphysis. The fourth and fifth pairs resemble the third in form and size, but do not carry a basecphysis.

The pleopoda are biramose.

The terminal pair forms part of the rhipidura and is biramose, the branches being subequal with the extremity of the telson.

Geographical Distribution.—There are four or more species, and they range from the central area of the Pacific to the China Seas.

Observation.—They are evidently the young of some unrecognised form. The specimens were few, generally one of each species, and at this stage the mandibles are without a synaphipod. The pleonic hump is suggestive of a comparison with the genus *Tozeuma*.

Caricyphus cornutus, n. sp. (Pl. CXXI. fig. 2).

The carapace is about one-fifth the length of the animal and is anteriorly produced to a rostrum that is sharp pointed and armed on the upper surface with two sharp teeth.

[1] καρίς, κυφός.

The first two somites of the pleon are short; the third is very long, and has the posterior dorsal portion placed at a right angle to the anterior portion, the angle being posteriorly produced to a large curved tooth or hook; the fourth and fifth somites are shorter than the third by more than half its length. The sixth is very long and narrow.

The telson is about three-fourths of the length of the sixth somite and terminates in a point tipped with a few hairs.

Length, entire,	6 mm. (0·2 in.).
„ of carapace,	1·5 „
„ of rostrum,	0·5 „
„ of pleon,	4·5 „
„ of third somite of pleon,	1 „
„ of sixth somite of pleon,	1·5 „
„ of telson,	0·7 „
„ of ophthalmopod,	1 „
Diameter of ophthalmopod,	0·8 „

Habitat.—October 27, 1874, near Samboangan, Philippine Islands. One specimen.

The carapace corresponds in length with the anterior portion of the pleon as far as the dorsal angle on the third somite, or about one-fourth the length of the entire pleon; it is anteriorly produced to a rostrum that is about one-third the length of the carapace, and armed with two sharp teeth on the crest, or frontal region, and smooth on the lower margin. The fronto-lateral angle of the carapace is produced to a sharp tooth.

The pleon has the first two somites short, but laterally almost as deep as the carapace, and has the fronto-lateral angle anteriorly produced to a sharp tooth. The third somite appears quadrate when viewed laterally, the dorsal surface being produced near the middle, so that the anterior and posterior portions are situated at right angles to each other, and the angle formed by the two is posteriorly produced to a large tooth-like process that is curved posteriorly downwards, and like the two preceding has the fronto-lateral angle produced to a sharp tooth. The fourth somite articulates with the third at a right angle with the anterior somites; it is less deep and narrower than those anterior to it. The fifth somite is a little smaller than the fourth, and the sixth is three times as long, much narrower and less deep, and is produced on each side posteriorly to a small tooth.

The telson is long, tapers to a point, and equals about three-fourths the length of the sixth somite.

The ophthalmopoda are very large and orbicular, forming with the ophthalmus a nearly spherical body, that reaches beyond and above the rostrum, and projects laterally on each side, the ophthalmus occupying about the anterior third.

The first pair of antennæ has the peduncle three-jointed; the first joint is not quite as long as the ophthalmopod, and is slightly excavate to correspond with it; the second

and third joints are short, cylindrical, and terminate in two flagella, of which the inner is short and immature, and the outer is broken off.

The second pair of antennæ is long and slender, and carries a scaphocerite that is as long as the peduncle of the first pair and armed with a small tooth on the outer distal angle. The flagellum is slender, but it is broken off a little beyond the peduncle.

The mandibles have not been examined.

The first pair of gnathopoda is short and subpediform.

The second pair (fig. 2*i*) is long, slender, and pediform; it consists of six joints and terminates in a sharp-pointed unguis that is flanked by two short hairs, and resembles an unguiculate dactylos.

The first pair of pereiopoda (fig. 2*k*) is robust, gradually increasing in diameter from the meros to the propodos, whence it as gradually narrows to the extremity of the pollex, which is pointed, and terminates in a sharp unguis; the dactylos is short and apparently in an immature condition, it is rounded at the distal extremity, shorter than the pollex, and subapically tipped with a small spinule; the ischium and meros are short, and the basis carries a long, flat, and uniarticulate ecphysis. The second pair of pereiopoda resembles the first in form and appearance, but is a little longer and more robust; the dactylos, as in the first pair, is immature, and the basis is furnished with a similarly formed ecphysis. The third, fourth, and fifth pairs are uniform in character and size, they are subequal in length and terminate in a short, sharp dactylos; only the third pair is furnished with a basecphysis, which in form and appearance resembles those anterior to it.

The pleopoda are short and biramose, those of the sixth pair, forming part of the rhipidura, have the outer margin smooth and the inner fringed with hairs.

Observations.—The specimen from which the above description is taken is evidently an immature animal, but one that has nearly attained the characteristic features of the adult. The ophthalmopod may probably be relatively smaller in the mature specimen, and the flagella of the first pair of antennæ may be longer. The dactylos of the first two pairs of gnathopoda has probably an unguis attached to its extremity, and it is highly probable that the basecphyses, which resemble in appearance those of the genus *Oplophorus*, may like them be persistent throughout life. The pleopoda probably undergo a proportional change of size, but only a modification in form, and will have the branches fringed with hairs, which in our specimen are not developed; and the posterior pair may become longer in relation to the telson.

Caricyphus serramarginis, n. sp. (Pl. CXXI. fig. 3).

Carapace short, anteriorly produced to a horizontal rostrum, and dorsally armed on the frontal crest with a small papilla and a similar one on the cardiac region.

Pleon smooth on the dorsal surface, except for a tooth on the third somite. Lateral margins of the second and third somites fringed with a series of small teeth.

Length, entire,			10 mm. (0·4 in.).
„	of carapace,		1·5 „
„	of rostrum,		1 „
„	of pleon, to dorsal protuberance,	3 mm.	8·5 „
„	„ from dorsal protuberance to extremity of the telson,	5·5 „	
„	of sixth somite of pleon,		2 „
„	of telson,		1·5 „

Habitat.—August 11, 1874, Kandavu, Fiji Islands; surface. One specimen.

The carapace is about one-seventh the length of the animal, anteriorly produced to a long, sharp-pointed rostrum, it is dorsally smooth except for a small papilla on the frontal crest, and another somewhat larger on the cardiac region. The frontal margin is laterally produced to a point at the fronto-lateral angle, behind which, on the lateral margin, are two or three small teeth, which after a hiatus are repeated in a series to the posterior extremity.

The first somite of the pleon is divided into two subequal portions; the second somite is subequal in length with the first but not divided; and both have the lateral margins fringed with a serrature that is bolder on the first than on the second; the third somite has the generic condition of having one part, which is generally the longer, horizontal, and the other part perpendicular, the angle between the two being produced to a posteriorly directed tooth; the fourth somite is shorter than either of the preceding, and has the lateral margin smooth and posteriorly rounded; the fifth somite is still shorter, and has the lateral margin smooth and posteriorly produced to an angle; the sixth somite is as long as the three preceding, laterally compressed, and gradually narrowing to the extremity, where it articulates with the telson. The telson is about two-thirds the length of the sixth somite.

The ophthalmopoda are pyriform and about one-half the length of the rostrum. The ophthalmus is large and orbicular.

The first pair of antennæ has the peduncle subequal with the rostrum, the first joint long and the second and third short; the flagella are short and subequal, and there is a thick bundle of membranous cilia attached to the base of the stouter branch.

The second pair of antennæ is furnished with a scaphocerite that reaches beyond the extremity of the rostrum, and is armed with a tooth on the outer distal angle. The flagellum is wanting.

Since there is only one specimen the oral appendages have not been examined.

The pereiopoda are all developed as short, simple, seven-jointed appendages, each carrying a basecphysis equal to itself in length.

The pleopoda are biramose, the sixth pair being a little shorter than the telson and furnished with a tooth on the outer distal angle.

Observations.—I do not remember a species of any other form in which the lateral margins of the pleon are serrate. This species differs from the preceding in having basecphyses attached to the five posterior pairs of pereiopoda, but the immature stage of the specimen precludes a too rigid generic classification.

Caricyphus gibberosus, n. sp. (Pl. CXXI. fig. 4).

Carapace long, narrow, cylindrical, anteriorly produced to a small sharp-pointed rostrum that is armed on the upper margin with three or four teeth.

Pleon having the third somite posteriorly elevated to a large hunch; sixth somite longer than the preceding two. Telson nearly half as long as the sixth somite.

Length, entire,	. . . . .	13·5 mm. (0·5 in.).
„ of carapace,	. . . . .	4 „
„ of rostrum,	. . . . .	0·8 „
„ of pleon,	. . . . .	9·5 „
„ of third somite of pleon,	. . .	1·5 „
„ of sixth somite of pleon,	. . .	3 „
„ of telson,	. . . . .	1·5 „

Habitat.—September, 1875, Pacific Ocean, near the Sandwich Islands; surface. One specimen.

The carapace is rather more than a third the length of the animal, and has the dorsal surface anteriorly produced to a sharp-pointed rostrum, the upper margin of which is armed with three or four teeth. The anterior two somites of the pleon are short and subequal; the third is dorsally long, and projects posteriorly to a rounded hunch-like prominence that is produced horizontally in a line with the preceding somites; the lateral margins are shorter than the dorsal, and are anteriorly convex and posteriorly concave; the fourth somite inferiorly articulates with the posterior division of the third, and is, therefore placed at a right angle with the preceding somites, it is shorter than the third, and subequal with the fifth. The sixth is about three times the length of the fifth, and much narrower, gradually narrowing posteriorly.

The telson is about one-half the length of the sixth somite, and terminates in a styliform extremity.

The ophthalmopoda are ovate and scarcely longer than the rostrum (?).

The first pair of antennæ has the first joint about twice the length of the ophthalmopod, and the second and third subequal, short, and cylindrical. The flagella are broken off.

The second pair of antennæ has the flagellum broken off subequal with the peduncle of the first pair, and carries a scaphocerite that is subequal with the same.

The oral appendages have not been examined.

All the pereiopoda are broken off excepting the posterior pair, which is short and robust, and carries a long and slender basecphysis, which is also preserved attached to the third pair.

The pleopoda are biramose; the sixth pair is longer than the telson, and has the outer branch armed with a small tooth at the outer distal angle.

Caricyphus turgidus, n. sp. (Pl. CXXI. fig. 5).

Carapace one-fourth the length of the animal, dorsally produced anteriorly to a short, sharp, smooth rostrum. Third somite of the pleon posteriorly produced to a small hunch; sixth somite subequal with the two preceding.

Telson half the length of the sixth somite.

Ophthalmopod clavate, half the length of the carapace.

Length, entire,	8	mm. (0·3 in.).
„ of carapace,	1·8	„
„ of rostrum,	0·3	„
„ of pleon,	6·2	„
„ of third somite of pleon,	1·3	„
„ of sixth somite of pleon,	2	„
„ of telson,	1·3	„
„ of ophthalmopod,	1	„
„ of scaphocerite,	2	„

Habitat.—January 9, 1875, China Sea, off Luzon; surface.

The carapace is scarcely one-fourth the length of the animal, and anteriorly projects to a sharp-pointed rostrum that is scarcely one-third the length of the ophthalmopod; it is slightly elevated on the frontal crest, but not adorned with teeth, and over the cardiac region there is a small papilla in the median line.

The pleon has the anterior two somites subequal in length on the dorsal surface, but laterally the second is much longer than the first. The third somite is dorsally as long as the preceding two, and posteriorly projects to a small and angular hunch; the lateral margins are subequal in length with the dorsal but not parallel to it, the anterior portion being deep and convex, and the posterior narrow, concave, and parallel with the dorsal surface. The fourth somite articulates with the third at right angles, and is subequal in length; the fifth is shorter and narrower, and the sixth is long, slender, and subequal with the preceding two.

The telson is about half the length of the sixth somite, and terminates in a sharp point.

The ophthalmopoda are clavate, stout, and about half the length of the carapace; the ophthalmus is continuous with the peduncle and ovate.

The first pair of antennæ has the first joint subequal with the ophthalmopod, the second joint about half the length of the first, and the third subequal with the second. The flagella are wanting.

The oral appendages have not been examined.

The pereiopoda are broken off.

The pleopoda are biramose; the sixth pair is slender and has the outer ramus a little longer than the telson and armed with a small tooth at the outer distal angle.

Observations.—This specimen has a general resemblance to *Caricyphus gibberosus*, but differs in having the rostrum without teeth, the hunch on the third somite of the pleon not quite so prominent, and the ophthalmopoda much longer and more robust.

Caricyphus angulatus, n. sp. (Pl. CXXI. fig. 6).

Carapace one-fourth the length of the animal and anteriorly projected to a rostrum armed with small teeth; a small obtuse tooth stands on the frontal crest and another near the posterior margin on the dorsal surface.

The third somite of the pleon has the dorsal surface produced to an acute angle posteriorly; the sixth somite is about one-third the length of the pleon, or the same length as the carapace, and the telson is three-fourths the length of the sixth somite.

The ophthalmopoda are about half the length of the carapace.

The first pair of antennæ has the peduncle a little longer than the rostrum.

The second pair has the scaphocerite subequal to the rostrum in length.

The pereiopoda are in an immature stage and support long and slender basecphyses.

The posterior pair of pleopoda is biramose and about half the length of the telson.

Length, entire,	17	mm. (0·6 in.).
„ of carapace,	4	„
„ of rostrum,	2	„
„ of pleon,	13	„
„ of third somite of pleon,	2	„
„ of sixth somite of pleon,	4	„
„ of telson,	3	„

Habitat.—Station 146, December 29, 1873; lat. 46° 46′ S., long. 45° 31′ E.; near Marion Island; at the surface during the day-time. One specimen.

This species is long and slender, having the carapace one-fourth the length of the

animal, not including the rostrum; it is smooth generally except for two small tubercles in the median line, one standing on the postcardiac region, the other on the frontal crest at the base of the rostrum, which projects anteriorly in a straight line and is half the length of the carapace, it is armed on the upper margin with five or six small teeth, and with one on the lower margin near the apical extremity. The orbit is defined by a small, sharp tooth at the outer angle, whence the frontal margin recedes to the fronto-lateral angle, which is defined by a sharp and well-developed tooth.

The first two somites of the pleon are short, subequal in depth with the carapace, and have the lateral margins fringed with hairs. The third somite is continued dorsally in the same line to about twice the length of the preceding two, and is then bent at an acute angle downwards and forwards to the posterior part of the lateral margin, which lies subparallel to the dorsal surface, thus producing the dorsal surface into a huge posteriorly directed projection or hunch. The fourth somite is short, articulates with the third at a right angle, and appears to be incapable of extension in a more direct line with the preceding somites. The fifth somite is long and narrow. The sixth is about the same length as the carapace or three times as long as the fifth somite, and terminates abruptly in the median line posteriorly; it is armed on each side of the posterior margin with a long and slender tooth and inferiorly with another. The lateral margins of all the somites are fringed with hairs, which appear to increase in length posteriorly. The telson is long and narrow, fringed at the extremity with small hairs and on the lateral margin with small spinules.

The ophthalmopoda are pyriform, tolerably robust, and about the length of the rostrum. The ophthalmus is large and ovate.

The first pair of antennæ has the first joint of the peduncle longer than the ophthalmopod and curved to allow space for the movement of that organ; the second and third joints are short and cylindrical, reach as far as the apex of the rostrum, and support two short and apparently immature flagella.

The second pair is furnished with a scaphocerite that is about the same length as the peduncle of the first.

As there is only one specimen of this species in the collection, I have not attempted to dissect out the oral appendages, which have, therefore, not been examined further than what can be observed of them in their natural position. The mandibles are situated only a little less than half the distance between the frontal and posterior margins of the carapace; they have no synaphipod, and are placed between two prominent labra.

The gnathopoda and pereiopoda appear to be incompletely developed; they each consist of six joints and a long basecphysis, of which the anterior is the shortest and the third pair of pereiopoda the longest, whereas the fourth and fifth pairs are as yet in an incipient condition.

The pleopoda are not apparent in the undissected animal, except the sixth pair, which is comparatively short, but foliaceous in character, and reaches to about half the length of the telson, and is armed on the outer margin with a small sharp tooth.

Rhomaleocaris, n. gen.[1]

Animal short and stout. Carapace dorsally round and smooth, anteriorly produced to a short straight rostrum, smooth on the upper surface, slightly dentate on the lower near the apex. Frontal margin produced to a strong tooth between the ophthalmopoda and antennæ; fronto-lateral angle produced to a point.

Pleon short, smooth; third somite the longest, and dorsally arcuate near its centre. Sixth somite short. Telson tapering.

Ophthalmopoda short and stout.

First pair of antennæ short, thick, and biramose.

Second pair of antennæ stout, and furnished with a short scaphocerite that is armed with a tooth on the outer margin.

First two pairs of pereiopoda chelate, and subequal in size. The three succeeding pairs short, robust, and simple, the posterior pair being a little the longest.

Observations.—It is difficult to determine the position of this genus in relation to the others. The specimens upon which it is founded are undoubtedly in an immature condition, and it is almost certain that several of the parts will become altered in relation to the rest in a very considerable degree. The flagella of both pairs of antennæ will probably become longer, the chelæ of the first two pairs of pereiopoda will acquire a more decided form, and the dactylos of the three posterior pairs of pereiopoda will possess a more distinct unguiculate character. Yet there are other parts which, however much they may vary, must still retain the generic characters, and these I have selected for the description of the genus.

Rhomaleocaris hamulus, n. sp. (Pl. CXIII. fig. 2).

Carapace one-fourth the length of the animal, smooth, anteriorly produced to a short lanceolate rostrum, serrate on the lower margin, and having the orbital tooth anteriorly produced to quite half the length of the ophthalmopod.

Pleon having the somites short and deep. Third somite dorsally arcuate and longer than the sixth. Sixth somite longer than the fifth, and not so long as the telson.

[1] ῥωμαλέος, robust; καρίς, a shrimp.

Length, entire,	8	mm. (0·3 in.).
„ of carapace,	2	„
Depth of carapace,	1·5	„
Length of rostrum,	1	„
„ of pleon,	6	„
„ of third somite of pleon,	1·5	„
„ of sixth somite of pleon,	1	„
„ of telson,	1·5	„

Habitat.—Pacific. Taken at the surface, associated with *Hectarthropus compressus*, on the passage from Api, New Hebrides, to Cape York.

The animal is broad, short and stout, and free from ornamentation on the carapace and pleon. The carapace is nearly as deep as the length between the orbital and posterior margins, it is anteriorly produced to a short rostrum (fig. 2c) that is laterally compressed and pointed at the apex, and only feebly serrate, if at all. The orbit is broadly excavate, and has the outer canthus armed with a long, straight tooth, the extremity of which is curved into a well-formed hook (fig. 2c″), whence the frontal margin is excavate to receive the second antennæ, the fronto-lateral angle being produced to a strong tooth.

The pleon is smooth, and all the somites are short; the third, which is the longest, is arcuate dorsally near the centre, and the fourth somite articulates with it at a right angle to the anterior somites; the sixth somite is a little longer than the fifth, and the telson is a little longer than the sixth, and tapers to the distal extremity.

The ophthalmopoda are short and pyriform, the ophthalmus being orbicular, and not reaching as far as the extremity of the rostrum.

The first pair of antennæ is short, the peduncle reaching scarcely beyond the ophthalmopod, and not as far as the apex of the rostrum, and it terminates in two rudimentary flagella.

The second pair of antennæ has the basal joints very short and thick; the scaphocerite is subequal in length with the first pair, and the flagellum is broken off a little beyond the peduncle.

The first two pairs of pereiopoda are all short and chelate (fig. 2*k*); the others are short and simple, the posterior pair being a little longer than the preceding; they carry no basecphysis, but in each, attached to the membranous articulation of the coxal joint with the pereion, there is a small arthrobranchial plume.

The pleopoda are short and biramose. The posterior pair, which forms part of the rhipidura, is foliaceous and as long as the telson, which tapers to the posterior margin, which is fringed with hairs.

Anebocaris,[1] n. gen.

Differs from *Diaphoropus*, which it much resembles, in having the first pair of pereiopoda chelate; from *Caricyphus* in being without the characteristic hump on the third somite of the pleon, and in the shortness of the sixth somite; from *Parathanas* in having the carpos of the second pair of pereiopoda uniarticulate, and in having the carapace furnished with a supraorbital tooth.

Anebocaris quadroculus, n. sp. (Pl. CXXIII. fig. 1).

Animal robust. Carapace having a large protuberance over the gastric region; supraorbital tooth large.

Ophthalmopoda short, broad, and twice the length of the rostrum.

Chelæ of the first larger than those of the second pair of pereiopoda. Fifth pair reaching beyond the ophthalmopoda.

Length, entire,	8	mm. (0·3 in.).
„ of carapace,	2·5	„
„ of rostrum,	0·5	„
„ of pleon,	5·5	„
„ of sixth somite of pleon,	1	„
„ of telson,	1	„
„ of fourth pereiopod,	1·5	„
„ of fifth pereiopod,	4	„

Habitat.—June 1874, off Port Jackson, Australia. One specimen; taken at the surface at night, associated with a specimen of *Leptochela reversa*.

Off Sibago, Samboangan, Philippine Islands. One specimen.

October 23, 1874, off Basilan Strait. Five imperfect specimens.

China Sea, off Luzon. One specimen, with *Caricyphus*, *Sergestes*, and *Lucifer*.

January 1873, Zebu Harbour, Philippine Islands. Three specimens, with *Gonerichthys*.

The carapace is about half the length of the pleon or one-third the length of the animal, and is dorsally smooth, except for a prominent tubercle on the gastric region. The frontal margin is anteriorly produced to a smooth, horizontal, and sharply pointed rostrum that is about one-fifth the length of the carapace. The outer canthus of the orbit is not defined, and the fronto-lateral angle is produced to a sharp tooth.

The pleon is about twice the length of the carapace and has the somites generally subequal in length, the sixth being the longest and about the same length as the telson.

[1] ἄνηβος, immature; καρίς, shrimp.

The ophthalmopoda are short, thick, and borne on a short pedicle; the ophthalmus is produced to an obtuse point at the upper distal angle, which gives to the organ a quadrate appearance; hence the specific name.

The first pair of antennæ has the first joint of the peduncle a little longer than the ophthalmopod and curved to afford room for the latter; the second joint is less than half the length of the first, and the third is about half the length of the second; at the extremity there are two slender flagella, but they are broken in the typical specimen.

The second pair of antennæ carries a scaphocerite that has the margins parallel and reaches as far as the distal extremity of the peduncle of the first pair.

The first pair of pereiopoda (fig. 1*k*) is chelate and more robust than the second. The second pair (fig. 1*l*) is slender and chelate. The third and fourth pairs resemble each other and are a little shorter than the preceding, whereas the fifth pair (fig. 1*o*) is more than twice their length and possesses a large, projecting, coxal joint. The entire limb is as yet within its exuvium, and the extremity of the dactylos is broken off, but the form of the inner or new structure appears rather to follow the lines of the exuvium than to assume the form of the dactylos, shown in *Diaphoropus versipellis* (Pl. CXVII. fig. 3*o*).

The pleopoda are biramose and supported on a well-developed peduncle.

The rhipidura is well developed and has the lateral plates subequal and reaching a little beyond the extremity of the telson.

Observations.—The second pair of pereiopoda is smaller than the first, but it exhibits no sign of becoming multiarticulate, or the species might be thought to belong to *Parathanas*.

Bentheocaris,[1] n. gen.

Carapace scarcely one-third the length of the entire animal, smooth, anteriorly produced to a short rostrum. Frontal margin without any very decided tooth. Pleon having the five anterior somites subequal, the first two being rather the shorter, and the sixth longer than any of the preceding. Telson long and tapering.

Ophthalmopoda subequal with the rostrum, furnished with an ocellus mounted on a tubercle.

First pair of antennæ biramose.

Second pair supporting a scaphocerite of moderate proportions.

Mandible supporting a two-jointed synaphipod.

Second pair of gnathopoda long, slender, and pediform, and furnished with a basecphysis.

First pair of pereiopoda shorter than the second pair of gnathopoda, and terminating in a sharp point. Second pair of pereiopoda minutely chelate. Third pair long, slender,

[1] βένθος, χαρίς.

and terminating in a simple dactylos. Fourth pair similar to the third. Fifth pair a little more robust.

Pleopoda biramose, the ultimate pair being a little longer than the telson, and having the outer branch furnished with a diæresis.

Geographical Distribution.—Only two species of this genus are known; they were both obtained at more than two miles in depth in mid ocean, one in the Pacific, and the other in the Atlantic.

Bentheocaris exuens, n. sp. (Pl. CXXIII. fig. 3).

Animal slender, having the dermal tissue soft and membranous. Carapace dorsally flat and smooth, except over the frontal region, where it is armed with a few small teeth that are continued on the rostrum, which is bent downwards and terminates in a fine, pointed tooth.

Pleon long and subequal in depth with the carapace. First somite short, second a little longer, and both dorsally smooth; third quite twice the length of the second, and terminating in a horizontal tooth in the median line of the dorsal surface; fourth and fifth somites similarly armed, but the tooth is smaller on each; sixth somite about twice the length of the fifth, and armed with a small tooth or spine.

Telson subequal in length with the sixth somite, and terminating in two or three small hairs.

Length, entire,	16	mm. (0·6 in.).
,, of carapace,	5	,,
,, of pleon,	11	,,
,, of sixth somite of pleon,	3·5	,,
,, of telson,	3·5	,,

Habitat.—Station 285, October 14, 1875; lat. 32° 36′ S., long. 137° 43′ W.; South Pacific Ocean; depth, 2357 fathoms; bottom, red clay; bottom temperature, 35°. One specimen in the tow-net attached to the trawl.

The species resembles many of the deep-sea forms in being soft and membranous, and has a slender appearance owing to the shortness and want of depth of the pereion. The carapace is about one-third of the animal in length; its surface is smooth generally, and it is dorsally flat and anteriorly produced to a short, downwardly curved rostrum (fig. 3c), that is about one-fifth the length of the carapace, and armed on the dorsal surface with six teeth, those situated on the frontal region being short, while those towards the extremity of the rostrum are long and slender. The frontal margin of the carapace has an excavation above the orbit and beneath the rostrum, and a slight excavation below this represents the orbit, which is defined by a small point or pro-

jection corresponding with the first antennal tooth; the frontal margin then descends and is lost in its continuation with the lateral margin of the carapace.

The pleon is rather more than twice the length of the carapace; the first two somites are short and smooth, the third is longer, and armed with a sharp tooth that is horizontal, and when the pleon is extended impinges against the dorsal surface of the next somite; the three succeeding somites are similarly armed, but the teeth are much smaller. The sixth somite is laterally compressed, nearly twice the length of the fifth somite, and as long as the telson, which is tapering and longitudinally curved.

The ophthalmopod (fig. 3*a*) is about one-third the length of the carapace, and reaches a little beyond the rostrum; it is stout, being only twice as long as broad, and is furnished with an ophthalmus of less diameter than the stalk, and supports a protuberant ocellus.

The first pair of antennæ (fig. 3*b*) has a peduncle that reaches beyond the extremity of the rostrum; the first joint, which is subequal in length with the ophthalmopod, is broad and slightly excavate, and furnished on the outer side with a sharp stylocerite that is about half the length of the joint; the second and third joints are broad and short, and terminate in two flagella, the inner of which is short, slender, the articuli not being clearly defined, and the outer flagellum is multiarticulate, and fringed with hairs on the outer side and a series of membranous cilia corresponding with the number of articuli.

The second pair of antennæ is broken off at the extremity of the peduncle, the second joint of which is furnished with a long, flat, foliaceous scaphocerite (fig. 3*c*″), the inner margin of which is fringed with ciliated hairs, which are lost. Those present, being attached to the new skin, are seen protruding through the orifices left by the previous hairs.

The mandible and the other oral appendages have not been examined.

The second pair of gnathopoda is long and slender; it is probably six-jointed, but the terminal part is broken off. The second joint is furnished with a basecphysis that is about one-third its length.

The first pair of pereiopoda is shorter than the second pair of gnathopoda, and carries a long basecphysis, and terminates in a straight-pointed chela, the posterior margin of the propodos being fringed with a series of closely planted ciliated hairs.

The second pair of pereiopoda is considerably longer than the first, and like it is furnished with a long basecphysis, and terminates in a small chela that is not more than one-fourth the length of the propodos; the latter joint is not quite as long as, nor of greater diameter than, the carpos; the meros and ischium are fringed on the posterior margin with a closely planted series of ciliated hairs. The third pair of pereiopoda (fig. 3*m*) is longer than the second, it carries a long basecphysis, and terminates in a simple dactylos that is smooth on the posterior margin until near the base of the unguis, where there is planted a fasciculus of long hairs, and this is also represented by similar long hairs that fringe the distal extremity of the propodos, on the posterior margin of

which, at regular distances, are planted a series of solitary spinules, also present on the same margin of the carpos and meros. The fourth pair of pereiopoda (fig. 3*n*) is shorter than the third, and like it carries a long basecphysis, and terminates in a long, curved dactylos that is fringed at the posterior margin with a series of spinules, and furnished with a bundle of hairs at the base of the unguis; the distal extremity of the propodos is furnished with long spinules, and the posterior margin with distantly planted solitary ones, all of which have their margins near the base fringed with short stiff cilia. The fifth or posterior pair of pereiopoda (fig. 3*o*) is shorter than the fourth, and does not, like the preceding pairs, carry any basecphysis; it terminates in a short, stout, biunguiculate dactylos, and is fringed on both sides with short hairs; the propodos is long, and gradually increases in breadth, the distal extremity being posteriorly excavate, and the posterior angle armed with two long and stiff spines, between which the dactylos impinges and forms an imperfect chela; the posterior margin of the propodos is thickly fringed with a series of short inversely curved spinules, fringed at the posterior margins only near the extremity with short hairs, and at the distal extremity of the anterior margin with a series of long hairs that are fringed with pointed cilia.

The pleopoda are all unequally biramose; the anterior two pairs appear to be the more robust, although all have strong peduncles. The sixth pair has the rami unequal, the inner being lanceolate and fringed with hairs, all of which are rubbed off, and the outer is furnished with a small tooth which stands at the extremity of the diæresis, and the distal and inner margins are fringed with hairs which are lost in our specimen, but the points of articulation are conspicuous.

Observations.—This species, which was taken probably within a fathom of the bottom, is in a very peculiar condition, which suggests that the animal when captured was approaching the period of exuviation. Most of the new parts are visible beneath the transparent outer covering, so that the next skin can be observed in its more perfect and mature condition. The armature on the rostrum shows that the new teeth correspond in number with those of the preceding moult.

Bentheocaris stylorostratis, n. sp. (Pl. CXXIII. fig. 4).

Carapace less than one-fourth the length of the animal, elevated above the frontal region to a thin, laterally compressed crest that projects over the frontal margin in the form of a rounded rostrum, fringed with slender teeth, of which the anterior is longer than the others, styliform, and projecting straight forwards. The orbit is only imperfectly defined by a small point, beyond which is another that represents the first antennal tooth, and corresponding with the position of the second antennal tooth is a longitudinal ridge.

The pleon has the third somite dorsally carinated and armed in the median line with a strong tooth, the fourth and fifth somites with a minute point, and the sixth unarmed.

The telson is long, narrow and tapering.

The ophthalmopoda are a little shorter than the longest style on the rostrum, and furnished with a protuberant ocellus.

The first pair of antennæ has the outer flagellum very stout at the base and rapidly tapering to the apex.

The second pair of antennæ has the scaphocerite half as long as the first pair of antennæ.

The second pair of gnathopoda is robust.

The first pair of pereiopoda is robust and chelate. The second pair is more slender than the first and chelate. The third, fourth and fifth pairs are slender and monodactyle, each carrying a well-developed basecphysis.

The pleopoda are biramose, the posterior pair being longer than the telson.

Length, entire,	38 mm. (1·5 in.).
„ of carapace,	11 „
„ of rostrum,	1 „
„ of pleon,	27 „
„ of sixth somite of pleon,	6 „
„ of telson,	6 „
„ of outer plate of rhipidura,	8 „

Habitat.—Station 13, March 4, 1873; lat. 21° 38′ N., long. 44° 39′ W.; Mid North Atlantic; depth, 1900 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·8. Two specimens, one male (?).

The carapace is not quite one-fourth the length of the animal and has the fronto-dorsal region elevated to a laterally compressed and very thin crest, the margin of which is fringed with seven teeth; the smallest tooth is the posterior, standing on the gastric region, they gradually increase in size, the anterior two, especially the most anterior, being long and styliform. Between the cardiac and genital regions a transverse furrow traverses the dorsal surface. The orbit is not deep or clearly defined; the first antennal tooth is but a small point, and the second appears to be absent or worn off, but from it a longitudinal ridge runs subparallel with the lateral, proceeding nearly to the posterior margin of the carapace.

The first somite of the pleon is short and smooth, and the second is also short and longitudinally furnished with a small carina. The third somite is dorsally longer than the preceding two and elevated to a strong carina, that commences abruptly at the anterior margin and posteriorly projects to a strong, laterally compressed tooth; the fourth is nearly as long and is dorsally furnished with a small carina that posteriorly

projects to a small tooth; the fifth is like the fourth but not so deep, and the postero-lateral angle projects to a point. The sixth somite is longer than the fifth, more compressed, and not posteriorly armed with a tooth on the dorsal surface.

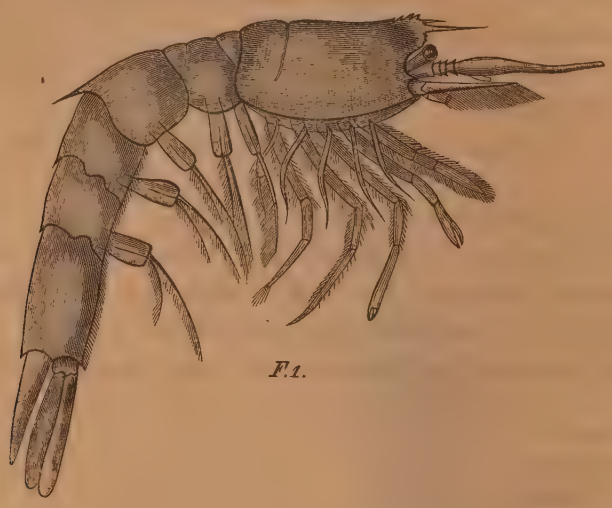

FIG. 72.—*Bentheocaris stylorostratis*, from a drawing by Dr. R. von Willemoes Suhm.

The telson is as long as the sixth somite and gradually tapers to a point.

The ophthalmopod (fig. 4*a*) is short and bulbous. The ophthalmus is brown in colour and of smaller diameter than the base, which is furnished on the inner and upper surface with a translucent papilla, in which there appears to be no ocellus, but an opaque mass at the distal extremity.

The first pair of antennæ is large and massive; the first joint of the peduncle is excavate on the upper surface and furnished with a small stylocerite on the outer margin; the second and third joints are short and thick, and each is furnished on the under surface with a fasciculus of long plumose hairs. The outer flagellum is large and broad, the upper surface being smooth and the under surface longitudinally excavate and thickly covered with soft membranous cilia; the terminal portion of the flagellum rapidly tapers to a long and slender extremity. The flagellum on the inner side is long, slender and cylindrical.

The second pair of antennæ has the flagellum broken off at the extremity of the peduncle; the second joint is armed on the outer distal angle with a sharp tooth, and on the inner with a scaphocerite that is about two-thirds the length of the first pair of antennæ, foliaceous on the inner margin, which is fringed with hairs, and rigid on the outer, but not armed with a tooth at the distal extremity, unless it be broken off.

The mandible (fig. 4*d*) is furnished with a two-jointed synaphipod, the basal joint being long, and the distal short, ovate and fringed with hairs, some of which are plumose.

The psalistoma is broad and serrate with eight teeth, of which the apical is the largest, the fifth next pronounced and the eighth short and broad; a small gap separates the series from the molar process, which is cylindrical and covered with many finely serrate points.

The first pair of gnathopoda is six-jointed; the coxa is furnished with a short disc-like mastigobranchia that supports a small podobranchia; the basis is broad and flat, and from its outer margin springs a long and slender ecphysis; the ischium and meros are continuous with the basis, but the carpos is broad and reflexed against the meros and continuous with the propodos, which terminates ovately and is furnished on its inside margin with long curved spines and strong hairs.

The second pair of gnathopoda is long, pediform and six-jointed; the coxa supports a slender rudimentary mastigobranchia and the basis a short and slender ecphysis; the ischium and meros are probably fused into one, they are flattened and inversely arcuate; the carpos is cylindrical, long, and continuous with the propodos, which is longer than the dactylos, which is short and tipped with short fringed spines; the last three joints are thickly studded with hairs that increase in number and strength towards the distal extremity, where they become fringed with minute hairs or tooth-like processes.

The first pair of pereiopoda is a little longer than the second gnathopod; the coxa carries a small rudimentary mastigobranchia and the basis a slender ecphysis; the ischium and meros are continuous; the carpos is moderately long and stouter than the meros, especially towards the distal extremity; the propodos is longer than the carpos but scarcely stouter, and terminates in a stout pollex and dactylos that form a chela that is about half the length of the palm. The second pair of pereiopoda is longer and more slender than the first; it carries a similar rudimentary mastigobranchia and slender basecphysis; the carpos is as long as the propodos, which terminates in a small chela. The third and fourth pairs of pereiopoda are longer than the second, quite as slender, and have the posterior margin of the meros and carpos fringed with distantly placed, slender, but strong, tooth-like spines; the dactylos is broken off both. The fifth pair resembles the preceding two excepting that the propodos increases in diameter distally and terminates in a short, robust, serrate dactylos (fig. 4*o*) enclosed within a bush of long hairs which are attached to the distal extremity of the propodos, the anterior margin of which for half its length is fringed with short curved serrate spines.

The first pair of pleopoda is long and slender; the anterior or outer ramus is long and tapering, and the inner is reduced to a foliaceous oval plate furnished on the outer side with a long stylamblys tipped with cincinnuli. The succeeding pairs of pleopoda are subequally biramose; the posterior, which forms the outer plates of the rhipidura, is longer than the telson and has the outer distal angle of the outer branch armed with a small tooth, the inner margin being fringed with hairs.

Acanthephyra, A. Milne-Edwards.

Acanthephyra, A. Milne-Edwards, Ann. d. Sci. Nat., sér. 6, tom. xi. p. 12, 1881.
„ Sidney Smith, Dec. Crust. Albatross Dredgings, 1883—in Rep. Commiss. Fish and Fisheries, p. 372, 1884.
Non *Miersia*, Kingsley, Proc. Acad. Nat. Sci. Philad., p. 416, 1879.
„ Sidney Smith, Bull. Mus. Comp. Zoöl., vol. x. p. 66, 1882.

Body laterally compressed and dorsally arcuate from crest to telson. Carapace smooth, compressed anteriorly to a greater or less carina, and produced to a long and slender rostrum that is furnished with a larger or smaller number of teeth on the upper and lower margins; frontal margin depressed and excavated to form an orbit, the outer canthus being defined by a rounded angle, external to which stands the first antennal tooth, then a second excavation is formed to receive the second pair of antennæ, at the lower angle of which the second antennal tooth projects, and beyond this the frontal margin of the carapace recedes obliquely backwards and inwards for a short distance, and is then continued still more abruptly inwards as the lateral margin, making a distinct angle with the branchial walls of the carapace, recedes from the frontal to the posterior margin.

The first somite of the pleon is as deep as the carapace, the posterior surface of which it laterally overlaps. The second and following somites are carinated, the four posterior being generally produced posteriorly in the form of laterally compressed teeth, which, when the animal is fully extended, lie against the dorsal surface and form a cultriform carina.

The telson is long, slender, and tapering.

The ophthalmopoda are short, oblong, and carry a small and imperfect ocellus.

The first pair of antennæ has the peduncle short; the first joint is excavate on the upper surface and carries a stout stylocerite; the second and third joints are cylindrical, and terminate in two long flagella.

The second pair of antennæ is long and slender, and carries a long and sharp-pointed scaphocerite, that articulates between two strong teeth.

The mandibles are deeply placed within the oral cavity; they have the psalistoma strongly serrate, concave, and continuous with the molar process, and carry a two-jointed synaphipod.

The first pair of gnathopoda is subpediform, seven-jointed, and has the distal joints enlarged and reflexed; the basis carries a long ecphysis, and the coxa supports a short mastigobranchial plate, to which is attached a small podobranchial plume and another is attached to the membranous articulation.

The second pair of gnathopoda is long, straight, pediform, and five-jointed; the three terminal joints are long, the distal one ends in a sharp styliform point; the basis is

short, and carries a long ecphysis; the coxa supports externally a lunate calcified plate that articulates with a rudimentary mastigobranchia, that is independent of any branchial plume, while near it a plume is attached to the membranous articulation.

The first two pairs of pereiopoda are short, slender, and chelate, and have the carpos uniarticulate; the basis carries a long ecphysis, and the coxa bears a short mastigobranchial plate. The posterior three pairs are simple in character, decrease successively in length, and terminate in a sharp-pointed dactylos, of which the posterior is much the shortest.

The pleopoda are biramose, narrow, and subfoliaceous. The terminal pair forms the outer plates of the rhipidura, which are subequal in length with the telson.

The branchiæ consist of twelve plumes and five mastigobranchial plates that are short and club-shaped, but sufficiently long to be able to penetrate for some distance between the plumes; the arrangement may be seen in the following table:—

Pleurobranchiæ,	...	...	1	1	1	1	1	1	1
Arthrobranchiæ,	1	1	1	1	1	1	...		
Podobranchiæ,	1	...	...	...	...	...	...		
Mastigobranchiæ,	1	1	1	1	1	...	...		
	h	i	k	l	m	n	o		

Of these the anterior are the smallest and the posterior the largest.

The arrangement of the branchiæ corresponds most closely with that of *Notostomus*, *Calymarina*, and *Hymenodora*, and approximates to that of *Nematocarcinus*, *Campylonotus* and *Oplophorus*, from which it departs chiefly in the smaller number and less important condition of the mastigobranchial plates.

The plumes are attached to the body at a point nearer to the lower extremity than is usual in this order, they being generally suspended more centrally.

Geographical Distribution.—The species that belong to this genus were taken by the Challenger in the Atlantic, off the south-eastern coast of South America, at a depth of 2040 fathoms, off the north-eastern coast of Australia in 2440 fathoms, south of Japan in 2425 fathoms, and in the Indian Ocean, 600 miles south of Australia, at a depth of 2150 fathoms. Other species were obtained off New Zealand in 1100 and 700 fathoms, off the Kermadec Islands in 600 fathoms, close to Japan in 500 fathoms, and in the shallow sea between Australia and New Guinea in 200 fathoms.

Acanthephyra acanthitelsonis was taken in Mid Atlantic at only two stations, not far from the equator, in depths of 1500 and 1850 fathoms respectively.

Acanthephyra brachytelsonis has been found in five different localities, namely, off the Kermadec Islands in from 250 to 630 fathoms, south of the Philippine Islands in 500 fathoms, off the south-eastern shores of South America, associated with *Acanthephyra agassizii*, at a depth of 2040 fathoms, close to the southern shore of Japan at depths

of 345 and 775 fathoms, and in the Sea of Banda, associated with *Acanthephyra rouxii*, at 200 fathoms, where also *Acanthephyra armata* was captured. This latter species is also reported by A. Milne-Edwards from Mexico at 422 fathoms, and he has also described two other species from the Gulf of Mexico under the names of *Acanthephyra debilis* and *Acanthephyra ensis*, off the Bahama and Barbados Islands, at the respective depths of 500 and 237 fathoms.

Acanthephyra brevirostris was taken in the North Atlantic, in 1500 fathoms of water, and *Acanthephyra longidens* was found off the north-western extremity of Celebes at a depth of 2150 fathoms, and at the very middle of the South Pacific Ocean at 2375 fathoms. *Acanthephyra media* was taken off Tablas Island, among the Philippines, at a depth of 700 fathoms. *Acanthephyra kingsleyi* was taken in Mid Atlantic at 2500 fathoms, just under the equator, and not far from the Stations where *Acanthephyra acanthitelsonis* was found. *Acanthephyra carinata* and *Acanthephyra approxima* were taken in narrow channels between the islands and the continent of South America on the western coast of Patagonia, at a depth of 400 fathoms. At all these localities the bottom was of a soft mud or Globigerina ooze, except in one instance off the Kermadec Islands, and once in the Atlantic, at Station 87, where the bottom was rocky.

The geographical range of this genus is almost cosmopolitan, but does not include the Arctic regions. Specimens have been found in the West Indies, among the islands of the Australian Archipelago, as far north as Japan, as far south as Kerguelen Island, and in the middle of the Pacific and Atlantic they have been taken at depths ranging from 200 to 2500 fathoms.

Observations.—A form closely allied to this genus was first described by Risso, under the name of *Pandalus pelagicus*, from a specimen taken in the Mediterranean. This name was afterwards changed by Roux, who more correctly demonstrated its true position in natural classification, to *Ephyra*, and this was retained by Professor Milne-Edwards.[1] More recently Professor Kingsley[2] pointed out that the name given by Roux had been previously adopted for another genus, and proposed the name of *Miersia* for Risso's species. But, judging from the description of Risso as quoted by Milne-Edwards, *Ephyra pelagica* "is ornamented on the sides by a curved suture with four spines and a channelled rostrum, armed with five teeth above and two and a fringe of cilia below."

Kingsley, moreover, places *Miersia* as the type of his Eryphinæ, making it a subfamily of Atyidæ, which, he says, "have the mandibles stout, non-palpigerous, with the crown broad, dilated, and slightly divided," neither of which characters correspond with those in the several species described under the name *Acanthephyra* of A. Milne-Edwards.

Acanthephyra of A. Milne-Edwards is not ornamented with a curved suture, unless one or two irregular depressions, as seen in *Acanthephyra armata*, but not universally

[1] Hist. Nat. Crust., tom. ii. p. 422. [2] *Loc. cit.*

present, can be so interpreted; neither are the four spines and the channelled rostrum present in the several species of the genus. A. Milne-Edwards says that *Miersia gracilis*, Sidney Smith, is identical with his *Acanthephyra debilis*, var. *europea*.

It consequently follows that as *Acanthephyra* of A. Milne-Edwards differs from Kingsley's description of *Miersia*, Milne-Edwards' name cannot be accepted as a synonym of Kingsley's type, viz., *Pandalus pelagicus* of Risso (*Ephyra pelagica*, Roux, *Miersia pelagica*, Kingsley). Mr. Sidney Smith[1] says—"As far as I know the only described species properly referred to this genus are *M. pelagica* and *punctulata* (Risso sp.), both apparently unknown to modern carcinologists, and *M. Haeckelii* (*Ephyra Haeckelii*, von Martens), all from the Mediterranean. *Ephyra compressa*, de Haan, placed in *Miersia* by Kingsley, had already been referred to *Atyephyra* by von Martens (Archiv für Naturgesch., xxxiv., 1868, pl. i. figs. 4*a* to 4*c*), and is certainly not closely allied to the species here described nor to *M. Haeckelii*."

That to which de Haan gave the name of *Ephyra* is a fresh-water species from Japan, and some confusion appears to have arisen in consequence.

Mr. Edward Miers, late of the British Museum, in a Note on a Fresh-water Macrurous Crustacean from Japan,[2] says that the species described by de Haan as *Ephyra ? compressa*, von Martens refers to the genus *Atyephyra* of Brito-Capello, and that "*Miersia* (*Ephyra*) has a marine habitat, and, as von Martens has shown, is distinguished by possessing a mandibular palpus, by the position of the inferior lateral spine of the carapace, the carinated post-abdomen, and by other characters." Mr. Miers says also that Mr. Kingsley's diagnosis of his family Atyidæ needs emendation as regards the mandibular palp.

Acanthephyra purpurea, A. Milne-Edwards (Pl. CXXIV. fig. 3).

Acanthephyra purpurea, A. Milne-Edwards, Comptes rendus, t. xcii. p. 1396, 1881. Recueil de Fig. de Crust. nouveaux ou peu connus, 1883.

Miersia agassizii, Sidney Smith, Bull. Mus. Comp. Zoöl., vol. x. p. 67, pl. xi. figs. 5–7, pl. xii. figs. 1–4, 1882.

Carapace slightly compressed, and anteriorly produced to a long and slender rostrum, armed on the upper margin with nine or ten rather distant teeth, and on the under margin with five or six.

Pleon subcarinated from the posterior margin of the second somite to that of the sixth, the third, fifth, and sixth being posteriorly produced to a tooth.

Telson longer than the sixth somite, gradually tapering to the extremity, the dorso-lateral margin being armed with several minute spinules.

Ophthalmopoda rather small and somewhat pyriform.

[1] *Bull. Mus. Comp. Zoöl.*, vol. x. p. 66.

[2] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. ix. p. 193, 1882.

First pair of antennæ having the first joint deeply excavate, and the outer flagellum very robust.

Second pair of antennæ having a long and pointed scaphocerite and a long slender flagellum.

None of the other appendages afford any character of specific value.

Length, entire,	. . . . .	38 mm. (1·5 in.).
„	of carapace, ...	10 „
„	of rostrum (broken), ...	8 „
„	of pleon, ...	28 „
„	of third somite of pleon, ...	5 „
„	of sixth somite of pleon, ...	7 „
„	of telson, ...	8 „

Habitat.—Station 354, May 6, 1876; lat. 32° 41′ N., long. 36° 6′ W.; south-west of the Azores; depth, 1675 fathoms; bottom, Globigerina ooze; bottom temperature, 37°·8. One specimen; male. Type.

Station 40, April 28, 1873; lat. 34° 51′ N., long. 68° 30′ W.; north-west of Bermuda; depth, 2675 fathoms; bottom, blue mud. One specimen. Dredged.

Station 87, July 21, 1873; lat. 25° 49′ N., long. 20° 12′ W.; off the Canary Islands; depth, 1675 fathoms; bottom, rock. One specimen. Dredged.

The label attached to one of the specimens says "deep haul, 6th May, 1876, Atlantic," and since the date corresponds with that of Station 354, there can be no doubt it was there obtained. The specimen is beautifully preserved both in form and colour, the latter being of a rich crimson-lake, which suffuses every part of the animal. The hairs which fringe the legs are long, delicate, and generally planted perpendicularly to the surface. There can be no doubt, I think, that it is the same species as that described by Mr. Sidney Smith as *Miersia agassizii*. When Kingsley changed the name of Roux's genus *Ephyra* into *Miersia*, he pronounced it to be a genus in which the mandible had neither synaphipod nor psalistoma, but since this species has both, it cannot belong to Kingsley's genus, *Miersia*, and undoubtedly belongs to A. Milne-Edwards' genus, *Acanthephyra*.

It is singular that every specimen that Mr. Sidney Smith obtained had the rostrum broken off; and this is also the case with our typical specimen, and is suggestive of its being very long and proportionally weak.

The only distinction between his species and the *Acanthephyra purpurea* of A. Milne-Edwards appears to exist in the armature of the rostrum, which Sidney Smith states has seven teeth on the upper surface, and four on the lower; but since in every specimen that came under his observation the rostrum was broken, I cannot see how he was able to determine either its length or the number of teeth on its surface. The ophthalmopoda are short, and the ophthalmus is not large. The antennæ and other appendages do not offer any feature of sufficient variation to denote specific distinction.

It closely resembles *Acanthephyra sica*, from the neighbourhood of New Zealand, from which it appears to differ only in having the denticles on the frontal crest larger and more distantly placed, and, according to A. Milne-Edwards and Sidney Smith, in having no tooth on the fourth somite of the pleon. Nevertheless Sidney Smith found it present in one out of the three specimens he examined: to quote his own words, "the carina being most conspicuous on the third somite, where it projects posteriorly in a very long and slender tooth. There is a similar but much smaller tooth on the three succeeding somites, though in two of the three specimens examined it is nearly or quite obsolete on the fourth somite."

Sidney Smith's specimen was taken in nearly the same degree of latitude, but between 30° and 40° further west.

Acanthephyra longidens, n. sp. (Pl. CXXIV. fig. 4).

Carapace smooth, anteriorly compressed, and slightly carinated and produced to a narrow, slender rostrum, directed obliquely upwards, dorsally armed with a crest of three small teeth, whence it is continuously smooth to the apex. Under margin smooth at the base, where it carries a series of long hairs, and armed towards the apical extremity with six small teeth. The two antennal teeth are small.

Anterior three somites of the pleon divided into two portions, dorsally smooth and without a carina. Third somite having the posterior division carinated and produced to a long, slender, spine-like tooth, that runs parallel with and extends beyond the posterior extremity of the next succeeding somite. Fourth and fifth somites slightly carinated but not posteriorly produced; the sixth is slightly carinated and posteriorly produced to a small tooth.

Telson dorsally smooth, rounded, laterally compressed, and armed with several small spines on each side; the extremity, terminating in two or three spines, reaches beyond the outer ramus of the rhipidura.

Ophthalmopoda small, and the other appendages rather short.

Length, entire,	68 mm. (2·6 in.).
„ of carapace,	19 „
„ of rostrum,	17 „
„ of pleon,	49 „
„ of third somite of pleon,	9 „
„ of sixth somite of pleon,	10 „
„ of telson,	18 „

Habitat.—Station 198, October 20, 1874; lat. 2° 55′ N., long. 124° 53′ E.; near the Philippine Islands; depth, 2150 fathoms; bottom, blue mud; bottom temperature, 38°·9. One specimen; male. Trawled.

Station 285, October 14, 1875; lat. 32° 36′ S., long. 137° 43′ W.; South Pacific Ocean; depth, 2375 fathoms; bottom, red clay; bottom temperature, 35°. One specimen; male. Trawled.

This species is remarkable for the long and slender spine-like tooth on the posterior margin of the third somite of the pleon, the length of which is in marked contrast with that of all the other teeth, which are peculiar for their smallness.

The ophthalmus (fig. 4*a*) is of smaller diameter than the ophthalmopod, and is situated on the outer surface of the extremity.

The first pair of antennæ has the sensory cilia long and thickly packed together, and attached to the under surface of the base of the larger flagellum. The tooth at the outer margin of the distal extremity of the scaphocerite is small and unimportant.

The chelæ of the two anterior pairs of pereiopoda are small; the dactylos of the third pair is rather short, slightly curved, and serrate on the inner surface, and that of the posterior pair is short and almost obsolete.

Observations.—There are only two specimens in the collection; the more perfect is a male, and has the anterior branch of the first pair of pleopoda small, foliaceous, submembranous, and furnished with a small stylamblys without cincinnuli.

Both specimens were taken at a great depth and about 7000 miles apart.

Acanthephyra media, n. sp. (Pl. CXXIV. fig. 5).

Carapace dorsally flat and smooth to the frontal region, where it is laterally compressed and horizontally produced to a rostrum that is subequal in length with the carapace, the upper surface is armed with small teeth, which are numerous and closely packed at the base and widely separated towards the apex, and on the under margin with one (or two) at the base.

Pleon carinated, third and three succeeding somites being armed with a small tooth.

Telson long, tapering, and fringed on the distal margins with five or six small spinules.

Ophthalmopoda short and pyriform.

First pair of antennæ having the peduncle less than half the length of the rostrum.

Second pair of antennæ having a scaphocerite that is shorter than the rostrum; the flagellum is broken off at the length of the rostrum.

The rest of the appendages are imperfect, excepting the second pair of gnathopoda, which is slender, and the sixth pair of pleopoda, which has the external branch subequal in length with the telson.

	Female.	Male.
Length, entire, . . .	52 mm. (2 in.)	66 mm. (2·6 in.).
„ of carapace, . . .	14 „	17 „
„ of rostrum, . . .	12 „	11 „
„ of pleon, . . .	38 „	49 „
„ of third somite of pleon, .	7 „	8 „
„ of sixth somite of pleon, .	8·5 „	9 „
„ of telson, . . .	10 „	12 „

Habitat.—Station 207, January 16, 1875; lat. 12° 21′ N., long. 122° 15′ E.; off Tablas Island; depth, 700 fathoms; bottom, blue mud; bottom temperature, 51°·6. Two specimens; male (?) and female. Trawled.

The carapace is anteriorly compressed and produced horizontally to a rostrum that is subequal with it in length; it is armed on the upper surface with numerous small irregularly planted teeth, nine or ten being closely situated on the frontal crest, and three more distant from each other on the rostrum. The under surface is armed with one long slightly curved tooth situated near the base just above the orbit. In the second specimen (fig. 5c) there is a second smaller tooth near the middle of the rostrum.

The second and succeeding somites of the pleon are slightly carinated; the third, fourth, fifth, and sixth being posteriorly produced to a small tooth.

The telson is long, slender, and dorsally smooth, and armed at the sides and extremity with several small spinules.

The ophthalmopoda are pear-shaped and of moderate proportions, but exhibit no sign of an ocellus.

The first pair of antennæ is about half the length of the animal, and the second carries a scaphocerite that is a little shorter than the rostrum, and tapers to a rounded extremity, the tooth standing on the outer margin.

The pereiopoda are rather small but not feeble; most of them are broken off.

Observations.—There are two specimens of this species, and they differ in small details from one another, there being, for instance, two teeth on the under side of the rostrum in one specimen, and only one on the other. The latter is a female, and without being quite certain, I take the former, which is the larger of the two, to be a male. The most characteristic features are of little pronounced specific value, and are represented more or less decidedly in the different species of the genus.

Acanthephyra angusta, n. sp. (Pl. CXXIV. fig. 6).

Animal laterally compressed. Carapace dorsally smooth, anteriorly produced to a horizontal rostrum, armed on the frontal crest with six small teeth, and on the under margin with two near the middle.

Pleon having the third somite elevated to a large tooth, and the fourth, fifth, and sixth somites posteriorly produced to a small tooth.

Telson subequal in length with the sixth somite.

Length, entire,	. . . . .	74 mm. (3 in.).
„	of carapace, ...	20 „
„	of rostrum, ...	14 „
„	of pleon, ...	54 „
„	of third somite of pleon, including tooth (3 mm.), .	10 „
„	of sixth somite of pleon, ...	10 „
„	of telson, ...	12 „

Habitat.—Station 194, September 29, 1874; lat. 4° 34′ 0″ S., long. 129° 57′ 30″ E.; off Banda Island; depth, 200 fathoms; bottom, volcanic mud. Two specimens. Dredged.

The rostrum is about half the length of the carapace and projects horizontally, with a slight elevation towards the point; the upper surface is armed at the base, rather anterior to the frontal region, with six small teeth closely packed together, the rest being smooth; the lower margin is also smooth, excepting for the presence of two small teeth situated near the middle.

The pleon is dorsally carinated from the second to the sixth somite; the third somite is produced to a large tooth that overlaps the fourth for more than half its length; the fourth, fifth, and sixth somites are all produced posteriorly to a small tooth, the sixth somite is longer than the fifth, and the telson is subequal with it.

The ophthalmopoda (fig. 6*a*) are short, thick, and supported on a short and narrow stalk, which enlarges a little from the base and is distally as broad as the ophthalmus; there is a small ocellus communicating freely with the ophthalmus.

The first pair of antennæ has the first joint deeply excavate to receive the ophthalmopod, the second and third joints are short, thick, and subcylindrical, and do not reach beyond half the length of the rostrum; the outer flagellum is large and about the length of the carapace, the extremity being broken, the under surface is thickly fringed with sensory hairs; the inner and slender flagellum is missing.

The second pair of gnathopoda and first pair of pereiopoda are robust, and the chela of the latter short and thick. The rest of the pereiopoda are wanting, and the terminal pair of pleopoda is longer than the telson.

Observation.—The general aspect of the species is not unlike that of *Acanthephyra acanthitelsonis*, the chief points of distinction being the different armature of the rostrum and telson.

Acanthephyra sica, n. sp. (Pl. CXXV. fig. 1).

Dorsal surface of the pleon slightly arched, the four posterior somites terminating in small dorsal teeth, of which the anterior is occasionally slightly the largest.

Carapace smooth, slightly carinated dorsally, and produced anteriorly to a rostrum that is equal in length to the carapace, and armed on the upper surface with nine or ten widely separated small teeth, the posterior being closer to one another than the others, and with five on the lower corresponding with the anterior five on the dorsal surface.

Ophthalmopoda pear-shaped and not very large.

First pair of antennæ having the first joint deeply excavated for the reception of the ophthalmopoda, and having a thick stylocerite that is sharply pointed, and about as long as the ophthalmopod; the two following joints are short, cylindrical, and carry two flagella that are a little longer than the rostrum.

Second pair carrying a slender flagellum that is as long as the animal, and a rigid scaphocerite that gradually narrows to the extremity, where it terminates in a sharp point; at its base, standing on the margin of the second joint, are two short but strong and sharp teeth, one above the scaphocerite, and the other below it.

Mandible broad, and having the teeth on the incisive margin regularly serrate, the central one being the most prominent. The molar process is triangulate, and the synaphipod has the terminal joint short, broad, and tipped with hairs.

There is nothing very remarkable in the form of the gnathopoda or pereiopoda besides their generic features.

Posterior pair of pleopoda having the branches narrow, pointed, and scarcely as long as the telson; outer branch longer than the inner, and having a well-defined broad ridge, the outer side terminating in a small tooth corresponding with the diæresis.

Telson long and narrow, longitudinally channelled on the dorsal surface, and armed at the lateral margins with nine or ten short articulating spines.

	Female.	Male.
Length, entire, . . .	85 mm. (3·4 in.).	63 mm. (2·5 in.).
„ of carapace, . . .	21 „	16 „
„ of rostrum, . . .	21 „	17 „
„ of pleon, . . .	64 „	47 „
„ of third somite of pleon, .	12 „	8 „
„ of sixth somite of pleon, .	14 „	10 „
„ of telson, . . .	18 „	12 „

Habitat.—Station 168, July 8, 1874; lat. 40° 28′ S., long. 177° 43′ E.; off New Zealand; depth, 1100 fathoms; bottom, blue mud; bottom temperature, 37°·2. Four specimens; one male, three females. Trawled.

Station 40, April 28, 1873; lat. 34° 51′ N., long. 68° 30′ W.; north-west of Bermuda; depth, 2675 fathoms; bottom, blue mud. One specimen. Dredged.

Station 159, March 10, 1874; lat. 47° 25′ S., long. 130° 22′ E.; south of Australia; depth, 2150 fathoms; bottom, Globigerina ooze; bottom temperature, 34°·5. Two specimens; males. Trawled.

Station 169, July 10, 1874; lat. 37° 34′ S., long. 179° 22′ E.; near New Zealand; depth, 700 fathoms; bottom, blue mud; bottom temperature, 40°. Three specimens; one male (damaged), two females. Trawled.

Station 170, July 14, 1874; lat. 29° 55′ S., long. 178° 14′ W.; off the Kermadec Islands; depth, 520 fathoms; bottom, volcanic mud; bottom temperature, 43°. One specimen; male. Trawled.

Station 170A, July 14, 1874; lat. 29° 45′ S., long. 178° 11′ W.; near the Kermadec Islands; depth, 630 fathoms; bottom, volcanic mud; bottom temperature, 39°·5. Trawled.

Station 181, August 25, 1875; lat. 13° 50′ S., long. 151° 49′ E.; between Australia and the Solomon Islands; depth, 2440 fathoms; bottom, red clay; bottom temperature, 35°·8. One specimen; male. Trawled.

Station 194, September 29, 1874; lat. 4° 34′ 0″ S., long. 129° 57′ 30″ E.; off Banda Island; depth, 200 fathoms; bottom, volcanic mud. Four specimens; damaged. Dredged.

Station 230, April 5, 1875; lat. 26° 29′ N., long. 137° 57′ E.; south of Japan; depth, 2425 fathoms; bottom, red clay; bottom temperature, 35°·5. Two specimens; males. Trawled.

Station 235, June 4, 1875; lat. 34° 7′ N., long. 138° 0′ E.; south of Japan; depth, 565 fathoms; bottom, green mud; bottom temperature, 38°·1. Two specimens; one male, one female. Trawled.

Station 318, February 11, 1876; lat. 42° 32′ S., long. 56° 29′ W.; north of the Falkland Islands; depth, 2040 fathoms; bottom, blue mud; bottom temperature, 33°·7. One fine specimen; male. Trawled. Length, 84 mm.

When the animal is fully extended the carapace is about one-fourth the length of the animal, measured from the orbital margin to the extremity of the telson. The postero-lateral margins of the carapace pass under the coxal plates of the first somite of the pleon. A small carina traverses the dorsal surface from the cardiac region forwards, and is lost in the serrature of the rostrum. The rostrum projects forwards to a length that is subequal with the carapace, and is armed on the upper surface with ten small teeth that are closer together near the frontal region and more distant anteriorly; the under surface is armed with five teeth that coincide with the same number, tooth for tooth, on the upper surface, except the most anterior on the upper surface, which has no corresponding tooth on the lower. The outer canthus of the orbit is clearly defined by a rounded angle, and the first antennal tooth is small, and lies closely impacted between the bases

of the first and second pairs of antennæ. The second antennal tooth is also small, and continued as an angular ridge posteriorly to the hepatic fissure.

The pleon is carinated, the first somite is smooth, and separated into two portions, the anterior portion is equal in length to the posterior, and passes under the dorsal surface of the carapace, so as to be entirely hidden when the animal is extended, and the coxal plate overrides the lateral walls of the carapace, and has the anterior margin, which is as deep as the carapace, excavate to correspond with the curve of the latter. The second somite is also dorsally divided into two portions, of which the anterior passes beneath the first when the animal is extended; it is dorsally carinated on the posterior division, the carina commencing and terminating abruptly, the posterior extremity in the median line being emarginate to admit the anterior edge of the carina of the following somite. The third somite is also divided into two portions, of which the anterior, that passes under the preceding somite, is much smaller than the posterior, which is strongly carinated, the carina commencing abruptly with the posterior division, and continuing posteriorly to a small, laterally compressed tooth. The fourth and fifth somites resemble the third, but have no anterior division, and the dorsal carina and dental elevation are less conspicuous. The sixth somite is nearly as long as the preceding two, and like them is dorsally carinated and posteriorly produced to a tooth, and the coxal plates are either wanting or reduced to a minimum condition, as the lateral walls of the somite are continuous with the ventral surface.

The telson (fig. 1z) is narrow, tapering, and considerably longer than the sixth somite, and not much shorter than the carapace; it is dorsally grooved from just beyond the base to just within the apex, the sides are longitudinally depressed suddenly, and armed on the distal half with nine separate small spinules, and terminally with four.

The ophthalmopoda (fig. 1*a*) are somewhat pyriform and supported upon a small pedicle, from which they suddenly enlarge; they are slightly compressed laterally, and increase in size as they approach the ophthalmus, which is orbicular, and separated by a constriction from the base on which it stands, and which projects to a small tubercle on the inner side, and carries a small and somewhat imperfect ocellus on the posterior part, connected by a thin line of pigment with the ophthalmus.

The first pair of antennæ (fig. 1*b*) has the peduncle short or about a fourth of the length of the rostrum. The first joint is deeply hollowed on the upper surface to receive the ophthalmopod, and carries a stylocerite that is shorter than the first joint, and has the outer wall perpendicular, the apex of which is suddenly narrowed to a small sharp tooth, and the base strengthened by two small tubercles that project upon the dorsal surface between the outer canthus of the orbit and the first antennal tooth, against which the outer surface of the stylocerite presses and receives support when the antennæ are directed outwards. The second and third joints are short and cylindrical, and support two flagella, of which the outer is much larger in both sexes than the inner; the latter is

slender, cylindrical, and a little longer than the carapace, the former is broad at the base, and then suddenly tapers to a slender termination which is subequal with the inner in length; the lower surface is thickly matted with closely packed membranous cilia that stand on the rounded surface, and not in a hollow as in some genera.

The second pair of antennæ (fig. 1*c*) carries a long and pointed scaphocerite that is but little shorter than the rostrum; the inner or foliaceous portion tapers to the apex, where it gradually merges into the strong distal tooth; the outer margin is strengthened by a ridge which falls between two rigid and strong teeth standing on the outer and distal margin of the second joint of the peduncle. On the outer side of the ridge the upper tooth checks the backward action of the outwardly extended scaphocerite by falling into a longitudinal groove (fig. 1*c''*), and pressing against the elevated ridge on that side, and so making this organ an efficient weapon of offence.

The mandibles (fig. 1*d*) are deeply embedded in the oral cavity between the cheiloglossa in front (*ch.a*), which extends into and fills the cavity between the mandibles (*d*) and the metastomata (*m.a.*), which falls against them posteriorly. The psalistoma is broad, thin, concavo-convex, and serrate at the margin; it is continuous with the molar process, and carries a two-jointed synaphipod, of which the first joint is long, and the second short and disc-shaped.

The first pair of siagnopoda (fig. 1*e*) does not differ much from that of other allied genera; it is small, of considerable tenuity, and three-branched, the two inner branches being tipped with short, stiff spinules, and the outer smooth, membranous, and obtusely pointed.

The second pair (fig. 1*f*) consists of three broad plates of extreme tenuity, and one short and narrow; one of the inner plates is divided into two, and fringed on the inner margin with numerous closely packed short spinules, the inner basal one with long and slender hairs; the central is short, narrow, and obtusely pointed, and the outer is developed into a large mastigobranchial plate of extreme tenuity, and fringed with cilia, all directed anteriorly in a centrifugal manner.

The third pair of siagnopoda (fig. 1*g*) has three plates; the outer plate is broad, curved, and of great tenuity, and fringed with hairs; the concave inner margin is reflexed at nearly right angles longitudinally; at the base is a bifid mastigobranchial plate, free from hairs or cilia.

The first pair of gnathopoda is subpediform and seven-jointed; the terminal joints are reflexed, the basis carrying a long ecphysis, and the coxa a small mastigobranchial plate and podobranchial plume.

The second pair (fig. 1*i*) is pediform and five-jointed; the coxa carries a lunate disc-like plate, of which the upper horn is bifid, while to the lower horn is attached a short and rudimentary membranous mastigobranchial plate, and near the centre of the crescent a small podobranchial plume. The basis carries a slender ecphysis that is two-thirds of

the length of the next succeeding joint, which consists most probably of the ischium and meros united, and is curved to leave space for the oral appendages. The next joint is long and narrow, and probably represents the carpos, and the terminal joint is long, slender, and straight, obliquely truncate, and laterally fringed with a soft fur of short hair.

The first and second pairs of pereiopoda are chelate, the anterior pair is slightly shorter than the succeeding, and a little more robust; the carpos is long, nearly as long as the propodos, which is not larger in diameter, and terminates in two closely impinging fingers, of which the movable dactylos is more curved than the fixed pollex. The third, fourth, and fifth pairs of pereiopoda are simple and rather short, being scarcely longer than the first two pairs; the ischium and meros are rather stout, and the carpos is long; the third and fourth pairs terminate in a long and slender dactylos, while in the fifth pair it is short and supported by a brush of hair. All the pereiopoda, including the chelate pairs, and also the gnathopoda, carry a slender basecphysis that lessens in length on each posteriorly, but is never rudimentary, and all excepting the posterior pair carry a mastigobranchial appendage, which, though small, is sufficiently long to penetrate to about half their length between the branchial plumes, and fulfil, we may assume, some efficient duty connected with respiration.

The pleopoda are biramose, having a short basal joint and narrow, subfoliaceous, flexible branches; the inner in the female carries a long stylamblys tipped with a bundle of cincinnuli, except in the case of the first pair, which has the inner ramus reduced to a rudimentary condition and thickly fringed with plumose hairs, and without a stylamblys such as is present in *Acanthephyra armata*. The posterior pair of pleopoda, which forms the lateral plates of the rhipidura, is narrow and subequal in length to the telson, and the outer angle of the diæresis is armed with a tooth and small spinule.

The eggs are ovate and numerous, and of moderate dimensions.

The branchiæ are generic in character.

Observations.—This species appears to be both abundant and widely distributed; it was taken by the Challenger at eleven stations, more or less distant from one another, —in the Atlantic and Pacific Oceans, as far north as Japan, and as far south as New Zealand. It is a more perfect representative of the genus than *Acanthephyra armata*. Its bathymetrical range is also great, since it has been taken at a distance of from less than half a mile to about three miles from the surface of the ocean. It appears to be very prolific also, since some of the females that were captured carry a large number of small eggs.

The specimen taken at Station 318 in the South Atlantic Ocean is a variety that approximates somewhat both in size and features to *Acanthephyra acanthitelsonis*, which was taken in Mid Atlantic near the equator. It differs from the typical form in being larger, in having only three teeth on the lower margin of the rostrum, two of which

are near the apex, while the third stands alone near the centre of the rostrum, and none of them correspond with any on the upper margin, but stand nearly equidistant between them. It was taken associated with four specimens of *Acanthephyra brachytelsonis*.

Acanthephyra armata, A. Milne-Edwards (Pl. CXXV. fig. 2).

Acanthephyra armata, A. Milne-Edwards, Ann. d. Sci. Nat., sér. 6, tom. xi. p. 12, 1881.

Carapace armed on the frontal crest with five small teeth, closely packed together. Rostrum elevated anteriorly, smooth on the upper surface, and armed on the lower with one large tooth that gives a forked appearance to the rostrum.

Four posterior somites of the pleon dorsally carinated and posteriorly armed with four subequal teeth.

Telson subequal in length with the sixth somite of the pleon.

Length, entire (male),	88 mm.	(3·4 in.).
„ of carapace,	25 „	
„ of rostrum,	25 „	
„ of pleon,	63 „	
„ of third somite of pleon, including tooth (3 mm.),	15 „	
„ of sixth somite of pleon,	11 „	
„ telson,	15 „	

Habitat.—Station 194, September 29, 1874; lat. 4° 34′ 0″ S., long. 129° 57′ 30″ E.; off Banda Island; depth, 200 fathoms; bottom, volcanic mud. One specimen, male. Dredged.

The carapace is smooth, dorsally carinated, and anteriorly produced to a rostrum as long as the carapace, strengthened at the base by a ridge on each side, and armed on the upper surface with a crest of five small teeth placed closely together over the frontal region, whence it is smooth to the apex; the lower surface is armed with a large solitary tooth rather more than half-way between the base and the apex, and beyond this tooth the rostrum curves upwards. On each side above the branchial region is a small longitudinal elevation, that dies out anteriorly above the hepatic region and posteriorly before it reaches the posterior margin, which lies under the lateral walls of the first somite of the pleon.

The pleon is laterally compressed and dorsally carinated, except the first somite, which is smooth, and has the anterior margin of the coxal plate overlapping the posterior margin of the carapace and widely excavated. The second somite is dorsally carinated, but not produced to a tooth; the third somite is dorsally carinated, the carina commencing abruptly with the posterior division and being produced posteriorly to a strong laterally compressed tooth; the fourth somite is dorsally carinated, the

carina, commencing with the anterior margin of the somite, being continued posteriorly to a tooth that is smaller than the preceding. The fifth and sixth somites resemble the fourth, except that the posterior teeth are successively smaller.

The telson is slightly carinated anteriorly, flattened posteriorly, and terminates in four small spines; it is laterally depressed and furnished with three or four almost rudimentary spinules.

The first pair of antennæ is subequal in length with the rostrum, and the upper flagellum carries on the under surface a thick mat of membranous cilia.

The second pair is slender and almost equal in length to the animal.

All the other parts appear to possess only generic characters.

Observations.—After having had the opportunity of examining the specimens in the possession of Professor Alphonse Milne-Edwards, I felt convinced that those procured by Professor Agassiz, off St. Lucia, in the West Indies, at a depth of 422 fathoms, were specifically the same as that taken by the Challenger in the Polynesian Archipelago at 200 fathoms; although the localities are distant, the variations between them are few and unimportant.

The type has the rostrum subequal in length with the carapace and gradually curves upwards from the base, the solitary tooth upon the lower margin being nearly on a level with the distal extremity of the scaphocerite.

The Challenger specimen has the rostrum rather shorter than the carapace, slightly curving upwards from the horizontal until the solitary tooth is reached, whence the direction is upwards and forwards, the apex being somewhat depressed. The five small teeth on the dorsal crest increase gradually in size from the posterior to the anterior, forming part of a carina, which commences on the cardiac region.

Acanthephyra acanthitelsonis, n. sp. (Pl. CXXV. fig. 3).

Carapace smooth, dorsum slightly elevated posteriorly. Rostrum slender, horizontal, armed on the upper surface with seven or eight small teeth and with four or five on the lower, and a small fasciculus of ciliated hairs at the base.

Pleon smooth, laterally compressed, and dorsally carinated in all except the first somite, which is smooth and posteriorly notched in the median line, as is also the second, whereas the third and succeeding somites are posteriorly produced to a sma overlapping tooth, of which that on the third somite is the largest.

Telson longer than the outer plates of the rhipidura, slender, armed with about forty strong articulating spines, twenty on each side, and terminating in two smaller ones at the extremity.

The first pair of antennæ is about two-thirds the length of the animal.

The second pair has the scaphocerite a little longer than the rostrum, longitudinally grooved, tapering, and abruptly terminating in a sharp point.

Length, entire,		103	mm. (4 in.)
,,	of carapace,	25	,,
,,	of rostrum,	15	,,
,,	of pleon,	78	,,
,,	of third somite of pleon, including tooth (2·5 mm.),	14·5	,,
,,	of sixth somite of pleon,	13	,,
,,	of telson,	24	,,

Habitat.—Station 106, August 25, 1873; lat. 1° 47′ N., long. 24° 26′ W.; Atlantic, south-west of Sierra Leone; depth, 1850 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·6. One specimen; male. Trawled.

Station 107, August 26, 1873; lat. 1° 22′ N., long. 26° 36′ W.; Atlantic, south-west of Sierra Leone; depth, 1500 fathoms; bottom, Globigerina ooze; bottom temperature, 37°·9. One specimen; male. Trawled.

Length 96 mm.

This species bears some resemblance to *Acanthephyra purpurea*, but it may readily be distinguished from it by the shortness of the rostrum and the less important dental armature on the back of the pleon, and on closer inspection by the more abundant and important spinules on the telson and the obtuse character of the scaphocerite.

The ophthalmopod carries a small tubercle on the inner side, and the ocellus is small and near the margin of the ophthalmus. Between the several pairs of pereiopoda, as they succeed each other, may be observed the small articulating plate that is very conspicuous in the genus *Astacus* and its fresh-water congeners, and also a strong tubercle carrying a fasciculus of extremely long, flexible, shortly ciliated hairs that penetrate between the branchial plumes.

The scaphocerite (fig. 3*c*) is a little longer than the rostrum and has the terminal tooth small and the inner squamous division slightly projecting beyond its point of union with the tooth; it is longitudinally grooved and ridged, and articulates between two supporting teeth on the distal margin of the second joint.

On the ventral surface, posterior to the fifth pair of pereiopoda, are two projecting, large, and conspicuous tubercles placed closely together, that are connected with the coxal joint; they are apparently the calcified sheath of the penis, which I have observed in another species.

Observations.—Both specimens are larger than the Challenger specimens of *Acanthephyra purpurea* and that of A. Milne-Edwards taken in the West Indies, but they are of about the same size as a variety of the latter species taken at Station 318, in the South Atlantic, off the south-eastern coast of South America.

Acanthephyra edwardsii, n. sp. (Pl. CXXVI. fig. 1).

Carapace laterally compressed and dorsally carinated, and anteriorly produced to a straight rostrum that is armed on the crest and upper margin with seven small teeth, two at the base and five in advance of the orbit, and with four teeth on the lower margin near the apex, distally and unequally separated from one another.

The second somite of the pleon is feebly carinated, the third is more distinctly so and produced to a slender tooth about one-third the length of the next somite; the fourth, fifth, and sixth somites are produced to a point that can scarcely be called a tooth.

The telson is long and tapering.

The three posterior pairs of pereiopoda are armed with numerous small spines on the posterior margin; the third and fourth pairs terminate in a long, styliform dactylos, and the fifth in a very small one.

	Female.	Male.
Length, entire, . . .	111 mm. (4·3 in.).	118 mm. (4·6 in.).
„ of carapace, . .	32 „	38 „
„ of rostrum, . .	23 „	22 „
„ of pleon, . . .	79 „	80 „
„ of third somite of pleon, including tooth (3 mm.),	17 „	17 „ (including tooth (4 mm.))
„ of sixth somite of pleon, .	13 „	14 „
„ of telson, . . .	19 „	21 „

Habitat.—Station 126, September 12, 1873; lat. 10° 46′ S., long. 36° 8′ W.; south of Pernambuco; depth, 770 fathoms; bottom, red mud. Two specimens; one male, one female. Trawled.

This species very much resembles *Acanthephyra carinata*, but may readily be distinguished from it by the form of the armature on the dorsal crest of the carapace. In *Acanthephyra carinata* the serrature is formed like a series of oblique divisions in the narrow carina, whereas in the present species it is formed as a row of distinctly separate teeth, five of which are near together and form the crest, and two or three others, which are more distant, upon the rostrum, the most distant being on a level with the posterior on the lower margin, from which to the apex the upper surface is smooth. The lower surface is armed with four teeth, the posterior corresponding with the anterior on the upper surface, the second is close to it, and the other two are subequally distant from each other and the apex. The dorsal carina is not very elevated and is continuous from the rostrum to the telson.

The pleon is arched and not strongly carinated, the carina culminating at the third somite, which is posteriorly produced to a tooth that is not very elevated but reaches to about one-third of the length of the fourth somite; the fourth somite terminates in the median line in a sharp tooth, almost at right angles; the fifth projects a very little, and the sixth is produced still more but not sufficiently to be described as a tooth.

The ophthalmopoda are short and flattened.

The joints of the peduncle of the first pair of antennæ are short and support a flagellum that is about as long as the carapace.

The second pair carries a scaphocerite that reaches to the extremity of the rostrum; it is broad at the base and gradually tapers to the distal extremity, where it is furnished on the outer margin with a small tooth. The flagellum in both specimens is broken short off.

The second pair of gnathopoda is a long and powerful organ, pediform in shape, and has the terminal joint long, robust, and styliform.

The second pair of pereiopoda is longer and more slender than the first, and the three following are furnished with small but well-formed spines along the posterior margins of the ischium and meros, but none on the carpos or propodos; the latter joint is straight, slender, and terminates in a dactylos that is long and styliform in the third and fourth pairs, but short and almost rudimentary in the fifth pair.

The first pair of pleopoda carries a small bud-like branch, attached to the inner and anterior side in the female, but produced to a larger leaf-like plate, somewhat truncate at the extremity, in the male.

The telson (fig. 1z) is broad at the base and tapers to the extremity, which is on a level with the inner plate of the rhipidura. The dorsal surface is rounded and free from any carina, the sides are compressed and smooth, having no teeth or spines except at the extremity, which is furnished with three or four short spinules.

Acanthephyra carinata, n. sp. (Pl. CXXVI. fig. 2).

Dorsal surface carinated from the rostrum to the telson. Rostrum about half the length of the carapace, anteriorly slightly elevated, dorsal surface and crest armed with six or seven short teeth; under surface armed with one tooth near the middle and immediately below the most anterior tooth on the upper, whence the rostrum is smooth to the apex. On each side of its base the rostrum is strengthened by an obliquely horizontal ridge. The dorsal carina dies out just within the posterior margin of the carapace, but is reproduced on the first somite of the pleon.

The first somite of the pleon is anteriorly smooth and posteriorly carinated. All the other somites are carinated, and the third, fourth, fifth, and sixth are posteriorly produced to a sharp tooth.

The telson (fig. 2z) is dorsally carinated on the anterior half and terminates posteriorly in a central tooth, flanked by three smaller ones.

The ophthalmopoda (fig. 2*a*) are short, broad, and furnished with a small ocellus.

The first pair of antennæ is about half the length of the animal and is furnished with a stylocerite that equals the length of the first joint.

The second pair of antennæ is longer than the animal, and supports a broad scaphocerite that terminates in a sharp point.

Length, entire (male),	120 mm. (4·7 in.).
„ of carapace,	38 „
„ of rostrum,	20 „
„ of pleon,	82 „
„ of third somite of pleon, including tooth (1 mm.),	18 „
„ of sixth somite of pleon,	15 „
„ of telson,	21 „

Habitat.—Station 310, January 10, 1876; lat. 51° 27′ 30″ S., long. 74° 3′ 0″ W.; Sarmiento Channel, Patagonia; depth, 400 fathoms; bottom, blue mud; bottom temperature, 46°·5. One specimen, male. Trawled.

This is one of the largest species of the genus, and is noticeable from having the carina on the first somite of the pleon, or at least on the posterior half, whereas in all other species this somite is free from great compression or dorsal elevation. The carina on the carapace extends to within a short distance of the posterior border, and is marked by a notch above the cardiac region. The rostrum is short, being only half the length of the carapace, and is styliform and slightly elevated anteriorly.

The scaphocerite is about the same length as the rostrum, and terminates in a sharp point formed by the tooth that arms the extremity of the outer margin. It is broader at the base than in most species, and the tooth on the distal angle of the second joint is sharp, strong, and furnished with long hairs on the lower surface.

The two anterior pairs of pereiopoda are slender and chelate. The two following are slender and terminate in a styliform dactylos, and the posterior pair is short. None of them have teeth or spines on the ischium or meros, but only a fringe of hairs.

Acanthephyra acutifrons, n. sp. (Pl. CXXVI. fig. 3).

Carapace laterally compressed and dorsally carinated in its entire length but especially over the frontal region, which is produced to a short, strong, sharp, laterally compressed rostrum, reaching nearly to a level with the extremity of the scaphocerite; the under margin is furnished with a denticular prominence, from which point to the base there is a longitudinal brush of hairs; the dorsal crest is armed with eleven teeth, which extend from the gastric region to half the length of the rostrum.

The dorsal surface of the pleon is carinated from the first to the last somite, and the four posterior somites are each posteriorly produced to a strong tooth, of which the anterior is the most important.

The telson is without a carina and is slightly grooved in the median line; it is armed on each side with three or four small spinules, and four on the terminal extremity.

The ophthalmopoda suddenly enlarge from the pedicle and carry a prominent tubercle on the inner distal extremity, just behind the ophthalmus, which is of a brown colour in our preserved specimen. The other appendages do not exhibit features of any peculiar specific value.

Length, entire,	81 mm. (3·1 in.).
„ of carapace,	30 „
„ of rostrum,	9 „
„ of pleon,	51 „
„ of third somite of pleon, including tooth (2 mm.),	12 „
„ of sixth somite of pleon,	9 „
„ of telson,	16 „

Habitat.—Station 191, September 23, 1874; lat. 5° 41′ S., long. 134° 4′ 30″ E.; off the Arrou Islands; depth, 800 fathoms; bottom, green mud; bottom temperature, 39°·5. One specimen, male. Trawled.

Station 213, February 8, 1875; lat. 5° 47′ N., long. 124° 1′ E.; near the Philippine Islands; depth, 2050 fathoms; bottom, blue mud; bottom temperature, 38°·8. One specimen, male. Trawled.

Length, 71 mm.

Station 214, February 10, 1875; lat. 4° 33′ N., long. 127° 6′ E.; south of the Philippine Islands; depth, 500 fathoms; bottom, blue mud; bottom temperature, 41°·8. One specimen, female (?). Trawled.

Length, 55 mm.

This species may easily be recognised by the shortness of the rostrum, which scarcely reaches beyond the extremity of the peduncle of the first pair of antennæ, and by the largely elevated character of the carina on the third somite of the pleon, the terminal point or tooth of which, instead of being directed straight backwards, is depressed.

The ophthalmi (fig 3*a*) are small and of a brown colour; the stalk is a little compressed on the upper side and the inner angle is anteriorly produced to a tubercle that encroaches upon the ophthalmus, but the ocellus, which is present in so many of these species, is small and connected with the ophthalmus.

There is nothing besides very distinguishing in the character of the species, except that the three posterior pairs of pereiopoda have the inferior margin armed with teeth that are longer and more spinous than usual.

Observations.—The distinction between the specimens, besides that of dimensions, appears to depend upon the character of their habitats. That which was taken from the deeper water is softer in its external tissue.

A comparison of these three specimens with each other, and with the genera *Tropirinus* and *Hymenodora*, shows how gradually varieties pass into species.

Acanthephyra kingsleyi, n. sp. (Pl. CXXVI. fig. 4).

Carapace anteriorly compressed and longitudinally produced to a small rostrum, armed on the upper surface with four small teeth and on the lower with one on the distal portion.

Pleon carinated from the second to the sixth somite. Third somite produced to a tooth at the posterior median line.

Telson shorter than the inner plates of the rhipidura.

Ophthalmopoda pear-shaped and furnished with an ocellus (fig. 4*a*).

Length, entire,	. . . . .	61 mm. (2·45 in.).
„	of carapace, ...	16 „
„	of rostrum, ...	9 „
„	of pleon, ...	45 „
„	of third somite of pleon, including tooth (2 mm.),	12 „
„	of sixth somite of pleon, . . .	9 „
„	of telson, ...	11 „

Habitat.—Station 104, August 23, 1873 ; lat. 2° 25′ N., long. 20° 1′ W.; Atlantic, south-west of Sierra Leone; depth, 2500 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·6. One specimen, male. Trawled.

The rostrum of this species is short in comparison with that of most other species, being about half the length of the carapace. The upper margin is horizontally in a line with the carapace, but the lower margin obliquely tapers to the apex. A single tooth stands beyond the middle of the lower margin, just under the second tooth of the upper; immediately behind and in advance of the eyes is a long brush or fringe of hairs.

The peduncle of the first pair of antennæ is long, reaching to about half the length of the rostrum; the stylocerite is nearly as long, and the flagella are longer than the carapace.

The scaphocerite of the second pair is about one-third longer than the rostrum, and narrows gradually to an obtuse point that is armed on the outer side with a tooth.

The carina on the dorsal surface of the pleon is not strong and the tooth of the third somite lies so closely pressed against the surface of the fourth that, without close observation, it looks like part of the carina.

Acanthephyra brevirostris, n. sp. (Pl. CXXVI. figs. 5, 6).

Carapace dorsally carinated and anteriorly produced to a rostrum that is about one-fourth the length of the carapace, and armed on the upper margin, from the gastric region to the apex, with nine or ten small teeth, and with or without one on the lower margin.

The pleon is smooth to the fourth somite, which dorsally projects to a small tooth in the median line, and a similar tooth is also present on the fifth.

The ophthalmopoda are short and pyriform.

The first pair of antennæ has the peduncle subequal in length with the rostrum, and the scaphocerite reaches considerably beyond it.

Length, entire,	41 mm. (1·6 in.).
„ of carapace,	14 „
„ of rostrum,	4 „
„ of pleon,	27 „
„ of third somite of pleon,	4 „
„ of sixth somite of pleon,	6·5 „
„ of telson,	8·5 „

Habitat.—Station 107, August 26, 1873; lat. 1° 22′ N., long. 26° 36′ W.; Atlantic, south-west of Sierra Leone; depth, 1500 fathoms; bottom, Globigerina ooze; bottom temperature, 37°·9. Two specimens. Trawled.

The carapace is slightly carinated and anteriorly produced to a rostrum that is scarcely one-fourth the length of the carapace, and is armed on the upper surface with nine small teeth; the orbit is deeply excavate, and from the middle a ridge runs obliquely to the hepatic sulcus, whence it passes to the posterior margin.

The pleon has the first three somites dorsally smooth; the three succeeding somites have a minute tooth in the median line, and the telson (fig. 6z) is long, tapering, and grooved in the median line, the ridges of the groove being furnished with small spinules.

The ophthalmopoda (fig. 6*a*) are short, about half the length of the rostrum, pyriform in shape, and furnished with an ocellus that is only partially detached from the ophthalmus; on the outer side of the ophthalmopod, beyond the margin of the ophthalmus, is a small but prominent process.

The first pair of antennæ has the peduncle reaching beyond the apex of the rostrum, and the second pair has the scaphocerite longer than the peduncle of the first.

The pereiopoda are all broken off.

The first pair of pleopoda (fig. 6*p*) is biramose, having the inner branch membranous.

The sixth pair has the branches slightly unequal, the inner being subequal with the telson and the outer longer.

Observations.—In the same bottle was a second specimen (fig. 6) which was found associated with it, and which differs from the preceding description in having ten teeth on the upper margin of the rostrum, and in having a small tooth on the lower margin, just beyond the distal extremity of the ophthalmopoda. In this specimen the first pair of pereiopoda is preserved and shows that it is a feeble and slender chelate organ. The two specimens in all other points correspond very closely; the latter is rather larger and

generally more robust; they may be only sexually distinct from each other, and, since they were taken in the same haul together, it is difficult to believe they are more than varieties of the same species.

This species resembles *Acanthephyra kingsleyi*, which may, however, be distinguished from it by having only four teeth on the upper margin of the rostrum, which is also proportionately longer, by the peduncle of the first pair of antennæ being shorter than the rostrum, and by the presence of a strong tooth on the posterior margin of the third somite.

Acanthephyra brachytelsonis, n. sp. (Pl. CXXVI. fig. 7).

Rostrum a little longer than the carapace, obliquely elevated, armed on the upper surface near the base with six small teeth, from which point it is smooth to the apex, the lower margin has one tooth about one-third its length from the apex, and two near together about one-third from the base of the rostrum. The third somite of the pleon is posteriorly produced to a long tooth, which reaches to about three-fourths the length of the next somite when the animal is extended, at which point a small depression marks its limit. The two succeeding somites are posteriorly produced to a point, but scarcely sufficient to be called a tooth; and the sixth is produced to a small one. The telson is smooth and shorter than the outer plates of the rhipidura.

	Male.	Female.
Length, entire, . . .	65 mm. (2·5 in.).	51 mm. (2 in.).
„ of carapace, . .	19 „	15 „
„ of rostrum, . .	19 „	12 „
„ of pleon, . . .	46 „	36 „
„ of third somite of pleon, including tooth (3 mm.),	14 „	9 „ (including tooth (2 mm.))
„ of sixth somite of pleon, .	10 „	7 „
„ of telson, . . .	13 „	10 „

Habitat.—Station 170, July 14, 1874; lat. 29° 55′ S., long. 178° 14′ W.; off the Kermadec Islands; depth, 520 fathoms; bottom, volcanic mud; bottom temperature, 43°. Four specimens; three males and one female. Trawled.

Station 170A, July 14, 1874; lat. 29° 45′ S., long. 178° 11′ W.; north of the Kermadec Islands; depth, 630 fathoms; bottom, volcanic mud. Four specimens. Trawled.

Length 75 mm.

Station 171, July 15, 1874; lat. 28° 33′ S., long. 177° 50′ W.; north of the Kermadec Islands; depth, 600 fathoms; bottom, hard ground; bottom temperature, 39°·5. One specimen. Trawled.

Length, 65 mm.

Station 194, September 29, 1874; lat. 4° 34′ N., long. 129° 57′ 30″ E.; off Banda Island; depth, 200 fathoms; bottom, volcanic mud. Two specimens. Trawled.

Station 214, February 10, 1875; lat. 4° 33′ N., long. 127° 6′ E.; south of the Philippine Islands; depth, 500 fathoms; bottom, blue mud; bottom temperature, 41°·8. Three specimens. Trawled.

Length, male 78 mm., female 67 mm.

Station 232, May 12, 1875; lat. 35° 11′ N., long. 139° 28′ E.; *Hyalonema*-ground, Japan; depth, 345 fathoms; bottom, green mud; bottom temperature, 41°·1. Three specimens; two males and one female. Trawl and dredge both used. Variety.

Length, male 75 mm., female 46 mm.

Station 236, June 5, 1875; lat. 34° 58′ N., long. 139° 29′ E.; south of Japan; depth, 775 fathoms; bottom, green mud; bottom temperature, 37°·6. One specimen, female. Trawled.

Length, 75 mm.

Station 318, February 11, 1876; lat. 42° 32′ S., long. 56° 29′ W.; north of the Falkland Islands; depth, 2040 fathoms; bottom, blue mud; bottom temperature, 33°·7. Four specimens; three males, one female. Trawled.

Length, male 66 mm., female 50 mm.

In this species there is a depression on the dorsal surface of the carapace corresponding with the cervical suture, which is connected with a lateral ridge that runs longitudinally from near the posterior margin of the hepatic region, and separates it and other regions from the branchial.

The ophthalmus (fig. 7*a*) is brown in colour, rather small, and the ocellus is not beyond the margin of the cornea.

The scaphocerite is shorter than the rostrum, and though it terminates in a small tooth, the inner squamose portion of the plate is more produced than usual and rounded at the extremity.

Observations.—The specimens vary somewhat in the number of the small teeth situated on the posterior dorsal surface of the rostrum; of the four taken at Station 170, two had six and two had seven, and one of those that had six above had four below, the fourth being situated close to the posterior; those that had seven above had only three below. Of the three specimens taken at Station 232, one had seven teeth on the dorsal crest, and three on the lower margin of the rostrum, one had eight on the crest and three on the inferior margin of the rostrum, and the third had nine on the dorsal crest and four on the lower margin of the rostrum. Of the three specimens taken at Station 214, two had seven teeth on the dorsal crest and the third had six, and all had three on the lower margin of the rostrum.

At Station 194 two small specimens were taken that must be considered as belonging to this species, with which they correspond in most points, excepting that the rostrum is not so long as the carapace and scarcely as long as the scaphocerite.

Acanthephyra approxima, n. sp. (Pl. CXXVI. fig. 8).

Carapace dorsally compressed, and carinated from the posterior margin to the rostrum, which is broken, slender almost from the base, and armed with seven teeth on the upper surface, the four posterior of which are small and closely packed together, the other three are larger, and the most anterior corresponds with the posterior on the lower margin, at which point the rostrum is broken. The first somite of the pleon is slightly carinated on the dorsal surface, the second is conspicuously so, the third and three following are carinated and produced posteriorly to a well-developed tooth.

The telson is anteriorly slightly carinated and terminates in a small brush-like extremity that does not reach beyond the distal extremity of the inner branch of the rhipidura.

Length, entire,	. . . . .	45 mm. (1·8 in.).
„	of carapace, ...	12 „
„	of rostrum, ...	?. „
„	of pleon, ...	33 „
„	of third somite of pleon, including tooth (1 mm.), .	7 „
„	of sixth somite of pleon, ...	7 „
„	of telson, ...	8 „

Habitat.—Station 310, January 10, 1876; lat. 51° 27′ 30″ S., long. 74° 3′ 0″ W.; Sarmiento Channel, Patagonia; depth, 400 fathoms; bottom, blue mud; bottom temperature, 46°·5. One specimen. Trawled.

The carapace is dorsally carinated from the posterior to the frontal margin, where it is produced to a rostrum that is armed on the upper surface at the base with four closely compressed teeth, and with three more separated on the rostrum, and one on the lower surface corresponding with the most distal on the upper, at which point the rostrum is broken.

The frontal margin beyond the second antennal tooth obliquely recedes until it reaches a point defined by the branchial margin of the carapace abruptly forming a sharp bend that is marked by an angle, which is posteriorly increased to a ridge that traverses the carapace from the anterior to the posterior regions. On the outer side of this ridge the surface lies at right angles with the rest of the carapace.

The pleon has the lateral walls perpendicular until they recede to the dorsal carina, which commences and ends abruptly on the second somite; it recommences on the third also abruptly, but is produced posteriorly to a long tooth at the posterior margin, and this is repeated in each of the following somites, the under surface of the tooth corresponding closely with the outline of the next somite, so that when the animal is extended the denticular character becomes a knife-like edge.

The telson (fig. 8z) is long, narrow, and tapering; it is longitudinally angulate in the dorsal centre and laterally compressed, the angle formed by the lateral compression being armed with three minute spinules, and the distal extremity with several small spines.

The ophthalmopoda (fig. 8*a*) are too stout at the base to be defined as pear-shaped. They are rather oblong, with the ophthalmus a little broader in diameter than the peduncle, and furnished with an imperfect ocellus that is connected with the ophthalmus laterally.

The first pair of antennæ has two flagella that are subequal in length with the carapace; the upper is much more robust than the lower, and has the inferior margin narrow and thickly fringed with membranous cilia. The peduncle is three-jointed; the first joint is excavate to receive the ophthalmopod, and is furnished with a stylocerite that is subequal in length with the joint that carries it, and abruptly terminates in a sharp point; on the outer margin, at the posterior extremity of this joint, a process which is surmounted by a small tubercle crowned with hairs rises perpendicularly and projects between the outer canthus of the orbit and the first antennal tooth on the margin of the carapace, and there has the power, on the elevation of the antennæ, of being locked and supported by the short rigid antennal tooth, which stands on its outer side.

The second pair of antennæ carries a slender flagellum that is subequal with the length of the animal. The scaphocerite is about three-fourths the length of the rostrum; it is sharp-pointed and the squamous portion tapers to the apex, where it is reduced to a minimum, a circumstance that increases the efficiency of the organ as a weapon of offence, for which purpose it is rendered more effective by the manner in which it is supported in position by the teeth on the basal joint.

The oral organs have not been examined in this species, since there is only a single specimen in the collection.

The second pair of gnathopoda reaches nearly to a level with the tooth on the under surface of the rostrum, it is fringed with small hairs on the inner margin and obliquely truncate at the apex, where it is tipped with small spines.

The pereiopoda are rather short, averaging a length that is subequal with the carapace, they are moderately robust and fringed on the posterior margins with hairs. The first two pairs are subequal with the others and have a long and narrow chelate hand, the fingers of which are subequal and about half the length of the palm. All the appendages, more especially the posterior, are brought close together in the median line, those on the two sides being in close contact.

The pleopoda are moderately long and robust. They possess a long, stout, laterally compressed basal joint that stands upon a rigid prominence, attached partly to the ventral surface of the pleon and partly to the inner wall of the coxal plate. The first pair has the branches unequal, in the only specimen of this species; the outer ramus is long, narrow, flexible, and rapidly tapering; the inner is short, almost rudimentary, and

furnished with a stylamblys near the apex, tipped with numerous cincinnuli. The other pleopoda have their branches subequal in length and a little broader than the first, and carry a long stylamblys, that diminishes in importance posteriorly, attached to the inner margin of the posterior branch, except in the posterior pair, which helps to form the rhipidura. The outer branch of this pair is armed with a tooth on the outer margin, coincident with the diæresis, and is as long as the telson.

Observations.—This species was taken associated with *Acanthephyra carinata*, which it resembles in the extent of the carinated condition of the dorsal surface from the rostrum to the telson, but the outline of the animal is less evenly arched, the pleon has the four posterior somites furnished each with a tooth of equal importance, and the rostrum, although broken off, is more slender at the base and proportionately longer. The ophthalmopoda are more cylindrical and the ophthalmus blacker, larger, and without a complete ocellus. The scaphocerite is not so broad at the base as in *Acanthephyra carinata*, but terminates in a point that is nearly as sharp. There is not much else in the specimen of specific importance, and if its rostrum be as long as the carapace and equally dentate, this specimen might be taken for a carinated variety of *Acanthephyra purpurea*, with the teeth on the frontal crest of the carapace a little more closely planted together.

Systellaspis,[1] n. gen.

Closely resembles *Acanthephyra*, but differs externally in the orbit being continued to the first antennal tooth and in the absence of a carina on the dorsal surface of the sixth somite of the pleon. The telson is dorsally grooved and terminates in a pointed extremity.

The ophthalmopoda are large, pyriform, furnished with an ocellus on the posterior surface and stand on long pedicles.

The scaphocerite tapers to the extremity, the inner division being rounded and the outer point being less conspicuous than in *Acanthephyra*.

A strong point or small tooth exists on the anterior margin of the first somite of the pleon, others are on the posterior margin of the fourth and fifth somites, half-way between the dorsal median line and the suture of union with the lateral coxal plates, and a pair of bolder teeth is repeated on the postero-lateral margin of the sixth somite.

Observations.—This genus is established chiefly on physiological grounds, the ova being very much larger and less numerous than in *Acanthephyra*, and I have frequently observed in closely allied forms that a difference in the size of the ovum means different stages at which the embryo quits the egg. In addition to this there are certain features in the specimen on which this genus is founded that enable us to distinguish it from

[1] *συστέλλω*, to compress ; *ἀσπίς*, shield.

those species that more distinctly belong to *Acanthephyra*. Among these is the absence of a carina on the sixth somite of the pleon, which, in the type on which I establish the genus, is replaced by a longitudinal groove, also repeated on the dorsal surface of the telson. The telson, instead of being truncated as it usually is in *Acanthephyra*, has a central prolongation that tapers to a point and is armed on each side with a variable number of spines.

There is also a peculiar and prominent point that projects from the anterior margin of the first somite of the pleon.

Acanthephyra debilis, A. Milne-Edwards (judging by the figures and description of the author) belongs to this genus, since he remarks that the eggs are large in size and few in number. The Challenger species, however, differs from his, which is figured as having four teeth only on the dorsal crest and nine upon the upper surface of the rostrum, whereas *Systellaspis lanceocaudata* has seven teeth on the crest and seven on the rostrum. *Acanthephyra debilis* has the posterior margin of the fourth and fifth somites crenated, while on those of *Systellaspis lanceocaudata* there is but one small tooth between the dorsal median line and the ridge of the coxal plates. A. Milne-Edwards does not say whether the sixth somite is dorsally channelled or not, but he figures it as being without a carina or a tooth on the posterior margin.

Geographical Distribution.—Only two species are known. *Systellaspis lanceocaudata* was taken off the southern coast of Japan in 345 fathoms, and *Systellaspis* (*Acanthephyra*) *debilis*, A. Milne-Edwards, was taken in the West Indies at 500 fathoms.

Systellaspis lanceocaudata, n. sp. (Pl. CXXIV. fig. 7).

Carapace carinated on the anterior portion only and produced to a slender rostrum that is longer than the carapace; armed on the upper surface at the base with a crest of seven teeth close together, and beyond with seven on the rostrum that are more distant from each other; and on the lower margin with seven similar teeth.

The pleon has the first two somites without a carina; the third and fourth are slightly carinated and centrally produced to a small tooth, of which the anterior is the longer, and the two following are flanked with a small tooth on each side. The sixth somite is dorsally grooved, as also is the telson, which terminates in a long median point flanked by four or five small spines.

The ophthalmopoda are pear-shaped, narrow at the base, and carry a large ophthalmus, with an oval ocellus and two small tubercles close together on the inner side and one on the outer that invades the ophthalmus.

The chelæ of the two anterior pairs of pereiopoda are short, narrow, and slender, the third and fourth pairs terminate in a long styliform dactylos, and the fifth pair in one that is short, curved and pointed.

Length, entire (female),	. . . . .	73 mm. (3 in.).
„ of carapace,	. . . . .	17 „
„ of rostrum,	. . . . .	21 „
„ of pleon,	. . . . .	56 „
„ of third somite of pleon,	. . . .	5 „
„ of sixth somite of pleon,	. . . .	13 „
„ of telson,	. . . . .	13 „

Habitat.—Station 232, May 12, 1875; lat. 35° 11′ N., long. 139° 28′ E.; *Hyalonema*-ground, off Japan; depth, 345 fathoms; bottom, green mud; bottom temperature, 41°·1. One specimen, female. Associated with *Acanthephyra brachytelsonis*. Trawl and dredge both used.

This species is interesting from its intermediate condition and from its resemblance in some points to the genus *Oplophorus*. It has a sharp and prominent tooth on the anterior margin of the first somite of the pleon, that is supported and strengthened by a small tubercle; this tooth, with the anterior margin, overlaps the posterior margin of the carapace. The orbital tooth is wanting, but the first antennal is large and projecting, as is also the second antennal tooth. There is no carina on the first and second somites of the pleon, but the third, fourth, and fifth somites are slightly carinated, the carina running to a posteriorly projecting tooth which decreases in size successively in each. The sixth somite is dorsally grooved and terminates without a tooth in the median line, but a well-formed tooth projects from the lateral margin half-way between the middle of the dorsal surface and the lateral articulation of the rhipidura.

The rostrum is narrow, long, depressed at the base, and then elevated to the apex, and strongly dentate with sharp spine-like teeth that are more closely placed over the frontal region than on the rostrum proper.

The ophthalmopoda are large and pear-shaped and supported on a slender stalk. They are situated at some distance from the median line, and on the outer side of the ophthalmus support a prominent tubercle, while on the corresponding inner side there are two small tubercles, and near the middle of the posterior surface, in a notch of the ophthalmus, stands an oval-shaped ocellus.

The first pair of antennæ is deeply excavate and carries a broad and laterally elevated stylocerite, the anterior margin of which is elevated into a transverse crest fringed with hairs, the whole of which forms a deep cup in which the eye lies and rests protected. The two succeeding joints of the antennæ are short and the flagella reach to half the length of the animal.

The second pair of antennæ has the scaphocerite tapering to the apex, but the squamous portion exists as a rounded extremity beyond the apical tooth, which is short and strong; at its base, standing on the second joint, is a long and powerful tooth, above which is a notch into which the scaphocerite falls when laterally extended, but there is no

strong ridge or tubercle on the under surface by which it is retained in position, as in the genus *Oplophorus*.

The fingers of the chelæ of the first two pairs of pereiopoda are long and slender, while the dactylos of the third and fourth pairs is long and styliform, and that of the fifth pair is short, stout, curved, unguiculate, serrate, and hidden amongst a brush of hairs more or less serrate and one strong spine at the extremity of the propodos.

The telson (fig. 7z) is subequal in length with the outer branch of the rhipidura, and terminates in a long and lance-like point of extreme sharpness, on each side of which are several small sharp spinules and one large one, from which the telson anteriorly gradually widens to the base. The dorsal surface is deeply grooved and the sides are compressed, the ridges so formed being armed with two distant rudimentary spinules.

Observations.—This species exhibits several features that are not common to those of the genus *Acanthephyra*, and are suggestive of an approximation to *Oplophorus*, but the resemblance is not complete.

It has some resemblance to *Acanthephyra purpurea*, but may readily be distinguished by the character of the orbit, the largeness of the eyes, the lateral teeth on the anterior margin of the first somite and on the posterior margins of the fourth and fifth somites of the pleon, by the dorsal groove and the absence of a tooth in the median line of the sixth somite, and by the form of the telson.

It closely resembles *Systellaspis* (*Acanthephyra*) *debilis*, A. Milne-Edwards, from which it may be determined by the number of the teeth on the dorsal crest of the carapace and by the absence of a crenated margin at the posterior dorsal surface of the fourth and fifth somites of the pleon.

Oplophorus, Milne-Edwards.

Oplophorus, Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 423.

Animal laterally compressed. Carapace about one-third the length of the body, dorsally carinated, and supported on each side by a subcarina, and anteriorly produced to a long and slender rostrum that is serrate on the upper and lower margins. Outer angle of the orbit defined by the first antennal tooth, which is curved inwards between the ophthalmopoda and the second pair of antennæ. The second antennal tooth is directed forwards and the fronto-lateral angle is produced to a tooth that is directed forwards and outwards, whence the lateral margin is abruptly directed inwards and so continues until it unites again, at the posterior angle, with a strongly projecting tooth. The posterior margin is but slightly produced laterally, and is compressed so as to be overlapped by the first somite of the pleon, and has a tubercle that corresponds

and is interlocked and articulates with the anterior margin of the first somite of the pleon.

The third and following somites of the pleon are posteriorly produced in the median line to long teeth, that correspond in form with the dorsal surface of the animal, so that when it is extended they rest upon the back in the form of a strong carina.

The telson terminates in a sharp point.

In some species there is also a tooth at the inferior margin of the coxal plate of the first somite of the pleon, which acts as a buffer against which the projecting tooth of the posterior angle of the carapace strikes when the animal rolls itself up.

The frontal surface of the margin near the orbit turns inwards and forms a sulcus, posteriorly narrowing to the hepatic region; anteriorly the outer canthus of the orbit appears to be lost or is coincident with the first antennal tooth, which is directed inwards and downwards and meets a small process attached to the upper surface of the peduncle of the second pair of antennæ, and so acts that when the scaphocerite is extended laterally it resists its return. The tooth that corresponds with the second pair of antennæ also assists in supporting the scaphocerite in an extended position. From the second antennal tooth to the fronto-lateral angle the margin descends vertically and is produced to a strong tooth that is directed outwards and forwards, the margin then turns abruptly inwards at right angles, and so continues along the lateral margin to a largely developed tooth at the posterior angle of the carapace. Near the middle of the lower border of the carapace there is a depression, not in the margin itself, but in the angle produced by a bent longitudinal curvature of it.

The ophthalmopoda are short and carry a large ophthalmus that has a circular ocellus closely impacted in its margin; on each side a small tubercle projects into the ophthalmus, and on the inner side, distant from the others, there is a small tubercle.

The first pair of antennæ has a short peduncle and carries two long flagella.

The second pair carries a long, strong scaphocerite, that tapers to a sharp point and is capable of being rigidly locked in position and unfixed at will, and a long and slender flagellum.

The mandibles have the psalistoma connected with a small molar process and support a synaphipod of three joints.

The first pair of gnathopoda is subpediform, and has the terminal joints reflexed.

The second pair is five-jointed; the ischio-meral joint is flattened, strongly curved, and the basis carries a long and flat ecphysis.

The first two pairs of pereiopoda are short, subequal, robust, and chelate, having the carpos short and uniarticulate. The following three pairs are short and terminate in a styliform dactylos, of which that of the posterior pair is somewhat the shortest; all carry a straight and rather broad basecphysis, and attached to the coxa of each, except the posterior pair, is a small mastigobranchia that passes between the branchiæ.

The branchiæ consist of five pleurobranchial, five arthrobranchial, and one podobranchial plumes, as shown in the following table :—

Pleurobranchiæ, . . .	...	...	1	1	1	1	1
Arthrobranchiæ, . . .	...	1	1	1	1	1	...
Podobranchiæ, . . .	1	...	...	...	...	...	...
Mastigobranchiæ, . . .	1	1	1	1	1	1	...
	h	i	k	l	m	n	o

In its branchial arrangement it agrees with *Acanthephyra* and *Notostomus*.

Geographical Distribution.—The original specimens described by Milne-Edwards were received from New Guinea, and those of the Challenger were taken off the Fiji, Philippine, and Admiralty Islands. Another species has been described by A. Milne-Edwards, from a specimen taken off the Island of St. Domingo.

Observations.—This genus is a very interesting one. Judging from their appearance, the species are active and pugnacious animals. The long, sharp, and bayonet-like scaphocerites must be capable of inflicting a deep wound, and their power is increased by the serrate condition of the outer margin, a feature that is seen in *Thalassocaris* also. Their power of progression must also be great, as may be seen from an examination of the leading features. The teeth upon the dorsal surface of the pleon can be tightly compressed against the body; the appendages not utilized are capable of being drawn close to the animal, and its narrow form and polished sides seem fitted to enable it to shoot through the water. With the rostrum and outstretched scaphocerites it will be capable of a formidable attack on animals larger than itself. In regard to its power of defence the dermal tissue is strong and rigid, and when at rest with the pleon curved under the ventral surface, the dorsal teeth extended, and the scaphocerites and rostrum pointed outwards and forwards, it cannot be easily approached, and by the manner in which the posterior teeth on the lateral margins of the carapace are supported by those on the lower margin of the first somite of the pleon, the animal appears to be capable of resisting a strong charge from an attacking enemy.

Oplophorus typus, Milne-Edwards (Pl. CXXVII. fig. 1).

Oplophorus typus, Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 424, pl. xxv. *bis*, figs. 6, 7.

Rostrum subequal in length with the carapace, armed on the upper surface with six small teeth and on the lower with seven.[1] The tooth at the infero-posterior angle of the carapace is directed obliquely backwards and outwards.

Pleon subcarinated; posterior margin of the first two somites rounded, that of the three following produced into long and sharp-pointed teeth. Anterior margin of the

[1] Milne-Edwards says seven or eight little teeth on each border, but as some of them are rudimentary the number probably varies.

coxal plate of the first somite elevated to a strong rib, inferior margin smooth and rounded.

Telson slightly longer than the lateral plates of the rhipidura.

Ophthalmopoda short, pyriform, and furnished with a small circular ocellus.

First pair of antennæ having the stylocerite reduced to a small tooth.

Second pair of antennæ having the scaphocerite subequal in length with the rostrum, sharp pointed, and serrate on the outer margin; flagellum about half the length of the animal.

Length, entire (female),	. . . . .	46 mm. (1·8 in.).
„ of carapace,	. . . . .	14 „
„ of rostrum,	. . . . .	15 „
„ of pleon,	. . . . .	32 „
„ of third somite of pleon, including tooth (7 mm.),	.	12 „
„ of sixth somite of pleon,	. . . . .	4 „
„ of telson,	. . . . .	9 „

Habitat.—Station 196, October 13, 1874; lat. 0° 48′ 30″ S., long. 126° 58′ 30″ E.; near the Philippine Islands; depth, 825 fathoms; bottom, hard ground; bottom temperature, 36°·9. One specimen, female, laden with ova. Trawled.

Station 220, March 11, 1875; lat. 0° 42′ S., long. 147° 0′ E.; north of New Guinea; depth, 1100 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·2. One specimen, female, laden with ova. Trawled.

This species was described by Milne-Edwards from specimens brought home by Quoy and Gaimard from New Guinea, but there are several points in it to which the author has not drawn attention, and which are of interest, and, so far as I am aware, peculiar to this form.

All the specimens in the collection are extremely compressed, and the sides deep and flattened, although Milne-Edwards says that "Le corps n'est pas comprimé." The rostrum is produced obliquely upwards, and is sharp and styliform, and armed on both upper and under surfaces with several small teeth, of which those on the lower side are the more important. The anterior margin corresponding with the outer canthus of the orbit is pointed and curved inwards; the tooth that corresponds with the second pair of antennæ is long, spinous, and directed anteriorly, while that at the fronto-lateral angle is directed forwards and outwards; from this point to the posterior angle the inferior margin is abruptly bent inwards, forming a longitudinal ridge that is anteriorly confluent with the fronto-lateral tooth, and posteriorly with the tooth at the posterior angle of the carapace. But the most remarkable feature of the carapace is a lateral process on the posterior margin that projects and lies beneath a corresponding process of the anterior margin of the first somite of the pleon, and bolts down the carapace so securely that it is difficult to elevate it. On each side of the dorsal carina corresponding

with the gastric region is a small longitudinal crest which continues to the anterior margin.

The ophthalmopoda (fig. 1*a*) are of moderate proportions, projected on a short stalk or pedicle and furnished with a small marginal ocellus at the posterior surface of the ophthalmus, while at the inner and outer surfaces there is a small tubercle.

The first pair of antennæ (fig. 1*b*) has the peduncle very short; the first joint is deeply excavate and carries only a rudimentary stylocerite; the two succeeding joints are extremely short, and both flagella are long, the inner being very stout at the base, and suddenly narrowing to a slender filament.

The second pair of antennæ (fig. 1*c*) is remarkable for the peculiar styliform character of the scaphocerite, which is subequal in length with the rostrum; the outer margin is serrate, and the inner fringed with closely packed hairs to within one-third of the length from the apex; near the base of the outer margin on the under side is a curved process, and near the hinge another lying parallel to it. On the second joint there is a large sharp-pointed and rigid tooth, at the base of which is a notch or groove upon the upper surface, which corresponds with the small tubercles or curved processes on the under side of the scaphocerite, so that when the latter is thrown outwards these curved processes fall into the notch at the base of the tooth, while the inner shoulder of the scaphocerite lies under the posteriorly directed antennal tooth, and thus the scaphocerite becomes locked rigidly in a position that makes it a strong bayonet-like weapon of offence.

The mandibles (fig. 1*d*) consist of a concavo-convex psalistoma or incisive plate having a closely serrate margin of regular dentition—the central tooth and the one at the anterior extremity being the largest—terminating with the molar process, into the hollow formed by which the synaphipod falls; the latter organ is three-jointed, the terminal joint being short, broad, and fringed with hairs.

The first pair of gnathopoda (fig. 1*h*) is short and has the terminal joints broad, flat, and reflexed, fringed on the inner side with hairs and stiff spines; the basis carries a long ecphysis that is flat and fringed with long hairs, and to the coxa is attached a small and almost rudimentary mastigobranchial plate, and a similarly developed podobranchial plume.

The second pair of gnathopoda (fig. 1*i*) is subpediform, having the ischium long, flattened, curved, and fused with the meros, the carpos and propodos subequal, the latter terminating in a point and fringed with soft hairs. The basis is short and carries a long, flat ecphysis, fringed with hairs. The coxa carries a rudimentary mastigobranchial plate that at the anterior extremity is produced to a straight tooth and at the posterior to a curved one.

The first two pairs of pereiopoda are chelate (fig. 1*k*), and are remarkable for the fusion of the meros and ischium into one joint, and the shortness of the carpos. The

first pair is shorter than the second and carries a longer basecphysis. The three terminal pairs of pereiopoda are subcylindrical and terminate in a styliform dactylos; they all carry a basecphysis, which gradually decreases posteriorly, and each a mastigobranchial appendage, except the posterior pair. The mastigobranchiæ are small, but cannot be considered as rudimentary, since they carry a membranous plate that passes to a considerable distance between the branchial plumes, except the penultimate pair, which has only the rudimentary stalk. The branchiæ are long, the posterior pleurobranchial and arthrobranchial plumes being particularly so; the foliaceous plates are long and narrow.

The first two somites of the pleon are dorsally smooth and laterally broad, deep, and rounded anteriorly; the third, fourth, and fifth are dorsally produced posteriorly into a styliform tooth that is subequal in length to the next succeeding somite, against the surface of which they lie, forming a sharp carina when the animal is extended, but when the rhipidura is compressed against the ventral surface of the pereion the dorsal teeth are elevated into formidable defensive weapons. The lateral coxal plates attached to these three somites are lunate, being excavated on the anterior margin and convex on the posterior, so that they are produced to a point at the infero-anterior margin.

The pleopoda are all biramose and subfoliaceous, the inner margin of the anterior plate being furnished with a broad and flat stylamblys in the female, to which sex all our specimens belong. The posterior pair, which helps to form the rhipidura, is shorter than the telson; the inner plate is narrow and pointed, the outer is broad and carries a diæresis armed with a small tooth on the outer angle.

The telson is long, sharp, and style-like, dorsally flat and laterally compressed, with one or two obsolete spines.

The ova are large, somewhat ovate, and about one-eighth of an inch in length; they are not numerous, being about a dozen in number, and the embryo appears to quit the ovum in the Zoea condition.

Oplophorus longirostris, n. sp. (Pl. CXXVII. fig. 2).

Like *Oplophorus typus*, but it differs in having the rostrum nearly as long again as the carapace, having eleven teeth on the upper surface and eight on the lower, the tooth at the postero-inferior angle of the carapace pointed outwards and forwards, the scaphocerite much shorter than the rostrum, and the antero-inferior margin of the coxal plate of the first somite of the pleon slightly excavate and the inferior margin produced to a point or tooth.

The dorsal teeth on the third, fourth, and fifth somites of the pleon are posteriorly elevated. In all other points this species agrees with the type.

Length, entire,	. . . . .	55 mm. (2·2 in.).
„ of carapace,	. . . . .	17 „
„ of rostrum,	. . . . .	23 „
„ of pleon,	. . . . .	38 „
„ of third somite of pleon, including tooth (10 mm.),		17 „
„ of sixth somite of pleon,	. . . .	4 „
„ of telson,	. . . . .	10 „

Habitat.—Station 174c, August 3, 1874; lat. 19° 7′ 50″ S., long. 178° 19′ 35′ E.; off Kandavu, Fiji Islands; depth, 610 fathoms; bottom, coral mud; bottom temperature, 39°. One specimen, female. Trawled.

Observations.—This species agrees very closely with that described by A. Milne-Edwards as *Oplophorus gracilirostris*, taken in 118 fathoms off the Island of St. Domingo in the West Indies, but as the author is silent upon what appears to be a distinguishing feature of this species, namely, the inferior margin of the first somite of the pleon being produced to a point or tooth, I think that this specimen is very probably different from that found in the West Indies, but a wonderfully close representative of it at the antipodes.

There is only one specimen in the collection, and it has been attacked by a parasite that is attached to the pleon, and fills the ventral space from the first to the third somite with a number of small egg-like bodies united in strings, end to end, increasing in size as they proceed, which will be reported on by Dr. Hoek in the Appendix.

Oplophorus brevirostris, n. sp. (Pl. CXXVII. fig. 3).

Rostrum short, about two-thirds the length of the carapace, armed on the upper surface with eight small teeth and seven on the lower; postero-inferior angle of the carapace having the tooth directed outwards and forwards, and having the scaphocerite longer than the rostrum.

First somite of the pleon having the antero-inferior margin of the carapace excavate but not inferiorly produced to a point or tooth; the teeth on the pleon are parallel with the dorsal surface when extended. In most other points this species agrees with *Oplophorus typus*.

Length, entire,	. . . . .	40 mm. (1·5 in.).
„ of carapace,	. . . . .	14 „
„ of rostrum,	. . . . .	8 „
„ of pleon,	. . . . .	26 „
„ of third somite of pleon, including tooth (5·5 mm.),		10 „
„ of sixth somite of pleon,	. . . .	4 „
„ of telson,	. . . . .	9 „

Habitat.—Station 207, January 16, 1875; lat. 12° 21′ N., long. 122° 15′ E.; off Tablas Island; depth, 700 fathoms; bottom, blue mud; bottom temperature, 51°·6. One specimen. Trawled.

This species in its general characters is very close to *Oplophorus typus*, only differing in such slight features that it is difficult to consider it as being more than a variety.

One peculiar feature worthy of notice is the translucent character of the carapace over the branchial region, so much so that the branchial plumes may be seen distinctly through it and their form determined.

Campylonotus, n. gen.[1]

Carapace longitudinally ribbed, anteriorly produced to a strong, laterally compressed, and deep rostrum, armed on the upper and lower margins with strong teeth; frontal margin having a first and second antennal tooth strongly developed at the anterior extremity of the longitudinal ridges, which are most conspicuous at the anterior extremity of the carapace. There is no supraorbital or hepatic tooth, and the rest of the carapace is smooth except for a small more or less dentate carina on the dorsal crest.

The pleon is smooth and the somites subequal, the third being dorsally arcuate and the sixth a little longer than the preceding.

The telson is long, gradually tapering to a point, dorsally smooth, and laterally compressed.

The ophthalmopoda are short and have a large subglobose ophthalmus, but carry no distinct ocellus.

The first pair of antennæ is biflagellate, and carries a strong stylocerite that is produced to a sharp point.

The second pair of antennæ carries a long, slender flagellum, and a scaphocerite that is broad, well developed, and strengthened by a longitudinal ridge that traverses the middle of the plate.

The mandibles are short, robust, and deeply inserted within the oral cavity, have the molar process and psalistoma connected by a serrate ridge, and carry a biarticulate synaphipod.

The first pair of gnathopoda has the terminal joints large and reflexed against the inner side of the preceding. The basisal joint carries a long and slender ecphysis, and the coxa a small mastigobranchial plate that supports a podobranchial plume.

The second pair of gnathopoda is pediform, six-jointed, carries a multiarticulate basecphysis, and the coxa supports a small mastigobranchia but no podobranchial plume; a small arthrobranchial plume arises from the membranous articulation connecting the leg with the somite.

The first two pairs of pereiopoda are chelate, the anterior pair being smaller than the second. The three succeeding pairs are simple, and a small rudimentary mastigobranchia that terminates in a strong curved point is attached to the coxa of each pair of pereiopoda excepting the posterior. None of the pereiopoda carry a basecphysis.

[1] καμπύλος, curved; νῶτος, back.

The ventral surface of the pereion is armed with three pairs of styliform teeth situated between the coxa of the two or three anterior pairs of pereiopoda.

Observations.—This genus corresponds much with *Gonatonotus*, A. Milne-Edwards, described from specimens taken in the West Indies by M. A. Agassiz during the expedition of the "Blake," and which he says approximates to *Oplophorus*.

Campylonotus differs, however, in general appearance from *Gonatonotus* in having no carinated tubercle on the third somite of the pleon, and in not having a finely serrate carina on the dorsal median line of the carapace, but three or four large teeth in place of it. It also differs structurally in having no basecphysis ("petit palpiform appendice") attached to the pereiopoda, while small basecphyses exist on all the pereiopoda of *Gonatonotus*, and in having the propodos of the second pair articulated near the middle and not inserted into an excavation in the anterior margin of the carpos.

It corresponds with Goës' genus *Caridion*, except in not having the carpos biarticulate. In *Caridion* also, judging by the European type, the second pair of pereiopoda is longer than, but not so stout as, the first, and the carpos is as short, and articulates with the propodos as in *Campylonotus*.

The branchiæ correspond more nearly with those of several genera of the Polycarpidea, such as *Pandalus*, *Heterocarpus*, and *Merhippolyte*, in which the mastigobranchiæ are short and rudimentary, rather than with those in its nearer congeners, *Palæmon* and *Oplophorus*, among the Monocarpidea. The arrangement of the branchiæ is given in the following table :—

Pleurobranchiæ,	.	.	.	...	r	1	1	1	1	1
Arthrobranchiæ,	.	..	.	...	1	1	1	1	1	...
Podobranchiæ,	.	.	.	1	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	1	r	r	r	r	r	...
				h	i	k	l	m	n	o

The mastigobranchial plate of the second pair of siagnopoda extends posteriorly as far as the penultimate pleurobranchiæ, and has the extremity tipped with long hairs that reach to the posterior limit of the branchial chamber.

Geographical Distribution.—The specimens of this genus were taken most abundantly in the channels among the rocky islands off the western coast of Patagonia, some specimens having been taken at every station at which the Challenger dredged in that locality.

The sexes are nearly equally abundant, but the males are smaller than the females, and the ova are moderately large and numerous.

Campylonotus semistriatus, n. sp. (Pl. CXXVIII. figs. 1, 2).

Carapace one-fourth the length of the animal, anteriorly produced to a rostrum subequal to it in length, dorsally carinated from the posterior margin, and armed with

four teeth on the upper margin and three on the lower. Laterally striated on each side with two obtuse carinæ, the upper corresponding with the first antennal tooth, the lower with the second antennal tooth.

Pleon smooth and dorsally rounded, terminating in a gradually tapering telson, which is slightly truncated at the extremity.

Ophthalmopoda short and globose.

First pair of antennæ subequal with the rostrum in length.

Second pair as long as the animal.

First pair of pereiopoda slender, the propodos scarcely stouter than the carpos. Second pair twice the length of the first, the chela being long, narrow, and a little more robust than the carpos. Third, fourth, and fifth pairs having the carpos and propodos subequal in length and terminating in a short serrate dactylos surrounded by a brush of ciliated hairs.

Pleopoda biramose; posterior pair subequal in length with the telson.

	Female (from Stn. 307).	Female (from Stn. 309).	Male (from Stn. 307).
Length, entire,	83 mm. (3·2 in.).	88 mm. (3·4 in.).	54 mm. (2·1 in.).
„ of carapace,	23 „	23 „	14 „
„ of rostrum,	28 „	28 „	16 „
„ of pleon,	60 „	65 „	40 „
„ of third somite of pleon,	15 „	14 „	8 „
„ of sixth somite of pleon,	8 „	14 „	8·5 „
„ of telson,	17 „	18 „	11 „
„ of first pereiopod,	31 „	32 „	18 „
„ of second pereiopod,	50 „	51 „	35 „
„ of fifth pereiopod,	43 „	48 „	32 „
„ of sixth pleopod,	19 „	20 „	11 „

Habitat.—Station 309, January 8, 1876; lat. 50° 56′ S., long. 74° 15′ W.; Puerto Bueno, Patagonia; depth, 40 fathoms; bottom, blue mud; bottom temperature, 47°. Three specimens, females.

Station 305A, January 1, 1876; lat. 47° 48′ 30″ S., long. 74° 47′ 0″ W.; Messier Channel; depth, 125 fathoms; bottom, blue mud. Six specimens; three males, three females. Trawled.

Station 306A, January 2, 1876; lat. 48° 27′ S., long. 74° 30′ W.; Messier Channel; depth, 345 fathoms; bottom, blue mud; bottom temperature, 46°. Three males, largest 68 mm. Trawled.

Station 307, January 4, 1876; lat. 49° 24′ 30″ S., long. 74° 23′ 30″ W.; off Port Grappler; depth, 140 fathoms; bottom, blue mud. Forty specimens; sexes about equally abundant. Trawled.

Station 308, January 5, 1876; lat. 50° 8′ 30″ S., long. 74° 41′ 0″ W.; off Tom Bay;

depth, 175 fathoms; bottom, blue mud. Nine specimens; seven females, two males. Trawled.

Station 310, January 10, 1876; lat. 51° 27′ 30″ S., long. 74° 3′ 0″ W.; Sarmiento Channel; depth, 400 fathoms; bottom, blue mud; bottom temperature, 46°·5. Six specimens; three males, three females. Trawled.

Station 311, January 11, 1876; lat. 52° 45′ 30″ S., long. 73° 46′ 0″ W.; off Port Churruca; depth, 245 fathoms; bottom, blue mud; bottom temperature, 46°. Four specimens; one female, three males. Trawled.

The carapace is dorsally carinated in the median line from the post-cardiac region to the anterior extremity, which is produced to a laterally compressed rostrum that is rather longer than the carapace, and armed above with four or sometimes five large teeth, two of which are posterior to the frontal margin and the others placed widely apart on the rostrum; the under margin is suddenly deeply produced and armed with three strong teeth. The rest of the carapace is smooth and polished, excepting for two short carinæ on each side, the upper of which commences at the frontal margin in the first antennal tooth and loses itself in the carapace, gradually lessening in intensity towards the posterior extremity; the second commences in the second antennal tooth, which stands just within the frontal margin, and loses itself just behind the hepatic region.

The posterior margin of the carapace is laterally overlapped by the anterior margins of the coxal plates of the first somite of the pleon.

The plastron or ventral surface of the pereion is triangular, rather broader at the posterior portion in the females than in the males. The two somites that carry the gnathopoda are so narrow that the appendages are almost in contact, but on the next somite, or that which carries the first pair of pereiopoda, there arises from the posterior margin on each side of the median line a long, sharp, and slender tooth, which from the base curves downwards and obliquely forwards (fig. 2).

On the next somite, or that which supports the second pair of pereiopoda, a second pair of teeth exists which are longer and broader at the base. On the next somite the teeth are shorter and exist more in the form of broad and obliquely planted plates, though in some specimens, especially from other stations, they are prolonged to flattened sharp-pointed teeth. Similar plates exist, but less conspicuously developed, on the two posterior somites, but in the specimens from Station 306A, which are males, they are both prominent and pointed.

The pleon is dorsally smooth, has no carina, and has the lateral plates large and deep. The third somite is slightly arcuate and dorsally compressed in a manner suggestive of an obsolete tubercle, such as exists in *Gonatonotus;* the posterior margin is slightly produced in the median line beyond the anterior margin of the following somite. The three posterior somites are narrower than the preceding, the fourth somite like the preceding

has the postero-lateral angle rounded, but that of the fifth is produced to a sharp angle, and above, just below the articulation of this somite with the sixth, is a projecting tooth. The sixth somite is longer than the preceding two and subequal with the third, gradually narrows posteriorly, is subcylindrical, and has the posterior margin produced to a sharp point between the sixth pair of pleopoda and the telson.

The telson tapers to a truncated apex that is fringed with fine hairs; the dorsal surface is flattened, the lateral margin depressed, and the longitudinal angle thus produced is furnished with five short spinules on each side.

The ophthalmopoda are short and supported at the extremities of the ophthalmic somite, which is partially protected by a projection of the metope that is produced to an obtuse point in the median line. The ophthalmus is large and reniform and the peduncle is reduced to a minimum; there is no distinct ocellus, but on the outer margin of the ophthalmus there is a projection of the pigment from the margin of the ophthalmus that looks like a rudimentary or obsolete organ of this kind.

The first pair of antennæ has the first joint long, broad, deeply excavate, and furnished with a stylocerite that is strong, sharp, and reaches beyond the distal extremity of the joint; the second joint is short and cylindrical, and the third, which is still shorter, supports two flagella that are subequal in length and reach a little beyond the apex of the rostrum.

The second pair of antennæ carries a scaphocerite that reaches beyond the peduncle of the first pair, but not to the extremity of the rostrum; it is broad and rounded distally, foliaceous on the inner and ridged on the outer margin, which terminates in a small sharp tooth; the flagellum is flexible and subequal in length to the animal.

The mandibles are strong and have the molar process connected with the psalistoma, the former being triangulate and the latter serrate, and having at the base a biarticulate synaphipod, the first joint of which is long and the second short and fringed with hairs.

The first pair of siagnopoda is three-branched; the two branches at the base are broad, foliaceous, and fringed with strong hairs, the third is curved, slender, tapering, and bifid at the extremity, the inner lobe supporting a long, stout, and strong hair, and the outer having several long, slender, and ciliated hairs.

The second pair of siagnopoda consists of two branches and a mastigobranchial plate; the branch nearest the base is broad, flat, and two-lobed, the inner margin being fringed with stiff hairs; the second branch is broad at the base and narrow at the apex, short and smooth; on the outer side is a long mastigobranchial plate, it projects anteriorly beyond the central branch and also projects posteriorly, gradually tapering to a point that is fringed with long hairs furnished with slender cilia that exist mostly towards their distal extremities.

The third pair of siagnopoda consists of a broad, foliaceous, concavo-convex plate, the margins of which are fringed with hairs, the inner being rigid and distally produced to a

long and tapering lash, and from its base originates a narrow plate conformable to the margin of the preceding, and on the inner side is a short, narrow, foliaceous branch of great tenuity; on the outer side, attached to the base, is a mastigobranchial plate that is constricted near its middle, one-half of which is directed anteriorly and the other posteriorly.

The first pair of gnathopoda is subpediform and six-jointed; the coxa carries a mastigobranchia with a small podobranchial plume; the basis supports a long and slender ecphysis that is covered with a thick brush of hairs at its base; the terminal two joints are coalesced together, reflexed against the preceding joints, and furnished on the inner surface with a thick brush of hairs, and at the lower distal angle, which corresponds with the extremity of the dactylos, with two strong stout spines.

The second pair of gnathopoda is pediform and five-jointed; the coxa carries a mastigobranchia with a short and rigid base supporting a membranous continuation of rudimentary character, but there is no branchial plume connected with it, although two small arthrobranchiæ are attached to the membranous articulation; the basis carries a short slender ecphysis, and the other joints are long, gradually taper to a truncated extremity, and are fringed with numerous slender hairs that gradually become spine-like at the extremity.

The first pair of pereiopoda is slender, reaching nearly to the extremity of the scaphocerite; the coxa carries a short, rigid mastigobranchia, tipped with a sharp tooth and fringed with hairs; the basis in this as in the other pereiopoda is destitute of an ecphysis, even of a rudimentary kind; the ischium is connected with the meros by an oblique and overlapping articulation; the carpos is short, slightly increases distally, and corresponds in diameter to the propodos, the palm of which is a little longer than the pollex and dactylos that lie in opposition to each other. The second pair of pereiopoda is constructed on the same plan as the first, differing only in being longer and slightly more robust. The third, fourth, and fifth pairs are simple, long and cylindrical, having the anterior distal angle of the carpos produced to overlap the propodal articulation, and terminating in a sharp-pointed serrate dactylos that articulates with the propodos in a thick brush of hairs.

The pleopoda are biramose, the two plates resembling each other, being broad, flat, and leaf-like, and nearly equal in length, the inner being the shorter, and both are fringed with long multiarticulate and ciliated hairs. The first pair differs from the others both in the male and female. In the latter the inner plate is shorter, broader, stiffer, and sparsely fringed with short hairs, and the outer is still shorter, more narrow, with a sparsely ciliated margin, and articulates at nearly a right angle with the inner, and when at rest generally lies directed outwards between the posterior extremity of the pereion and the anterior of the pleon. The second pair carries two stylamblydes, both of which are short, the outer is cylindrical, and terminates in a group of short cincinnuli, and the inner

smoothly pointed and fringed with a few flexible hairs. The three succeeding pairs carry a single stylamblys on the inner margin of the inner plate, which lessens in size posteriorly. In the male the inner plate is larger than in the female, and is broad, smooth, and membranous, the outer being narrow, short, and rigid.

The second pair of pleopoda, in the male, has the two branches nearly equal; the inner plate carries two unequal stylamblydes, the outer of which is the shorter, cylindrical, and bears a terminal lobe that is obliquely crowned with a circular group of short cincinnuli; and the inner, which is nearly as long as the plate to which it is attached, is flat, slightly curved, smooth on the inner side, and armed with short strong spinules on the outer, which increase in length towards the distal extremity, which is tipped with one short and two long and strong hairs, bordered with a short pilose fur. The third and succeeding pairs correspond with the second, excepting that there is but a single stylamblys, the short and cincinnulated one being retained.

The sixth pair forms the lateral plates of the rhipidura; they reach a little beyond the extremity of the telson, are rounded at the extremity, and fringed with ciliated hairs, the outer plate being armed with a short tooth on the outer margin.

Observation.—All the specimens of this species from the various localities were taken during the month of January, and none of the specimens were found with ova, although there are thirty-seven females in the collection.

Campylonotus capensis, n. sp. (Pl. CXXVIII. fig. 3).

Animal generally resembling *Campylonotus semistriatus*, having the dorsal carina armed with five teeth, three of which are on the carapace posterior to the frontal margin, and two upon the rostrum, the most anterior being small and subapical. The under surface is deep and armed with four teeth, of which the distal is small and subapical, but a little posterior to the most anterior on the upper margin. The first and second antennal teeth are posteriorly continued in the form of gradually decreasing carinæ.

	Female.		Male.	
Length, entire, . . .	66	mm. (2·65 in.).	48	mm. (1·5 in.).
„ of carapace, . .	17	„	13	„
„ of rostrum, . .	15	„	12·5	„
„ of pleon, . .	49	„	35	„
„ of third somite of pleon,	10·5	„	7	„
„ of sixth somite of pleon,	9	„	6	„
„ of telson, . .	14	„	10	„

Habitat.—Station 145, December 27, 1873; lat. 46° 43′ S., long. 38° 4′ 30″ E.; off Marion Island; depth, 140 fathoms; bottom, volcanic sand. Five specimens; three males, two females, one laden with ova. Dredged.

Station 122, September 10, 1873; lat. 9° 5′ S., long. 34° 50′ W.; off Pernambuco; depth, 350 fathoms; bottom, red mud. Two specimens, males. Trawled.

Carapace having the dorsal carina armed with three strongly developed, anteriorly directed teeth, posterior to the frontal margin, and two upon the rostrum, which gradually decrease anteriorly, so that the one nearest the apex is very small. The lower margin deepens abruptly towards the base and is armed with four well-formed teeth, of which the one near the apex is the smallest; the rostrum gradually curves upwards, but at the extremity turns slightly forwards, it is laterally compressed to very considerable tenuity, but is strengthened by a longitudinal rib from the base to the tip. The first antennal tooth is long, straight, and sharp-pointed, forming the anterior extremity of the upper carina that traverses the lateral wall of the carapace, and gradually diminishes in importance until it nearly reaches the posterior margin. The tooth that corresponds with the second antenna stands a little within the frontal margin, it is strong, sharp, and continuous with the lower carina that lies subparallel with the inferior margin of the carapace, and gradually dies out as it approaches the posterior margin.

On the ventral surface of the pereion, between the coxæ of the second and third pairs of pereiopoda, are two pairs of spine-like teeth, those between the second pair being the longer and more slender, while those between the coxæ of the third pair are shorter and broader, and more so in the females than in the males.

The pleon is dorsally rounded, having the third somite arcuate and overlapping the fourth, the fifth somite is laterally produced to a sharp point, and the posterior margin on each side of the median line is produced to a small tooth. The sixth somite is cylindrical and but little longer than the fifth; it is posteriorly furnished with a tooth both above and below the articulation of the sixth pair of pleopoda.

The telson is dorsally rounded and armed on each side near the posterior extremity with five or six almost obsolete spinules, and with two larger ones, and a few hairs, at the extremity on each side of a small median tooth.

The ophthalmopoda are pear-shaped, and the external margin of the pigment of the eye is dorsally waved, but there is no distinct ocellus.

The first pair of antennæ has the first joint dorsally excavate from the base to the distal extremity, and is armed on the outer side with a flat and distally pointed stylocerite that reaches to half the length of the second joint, which is cylindrical; the third joint is short, cylindrical, and carries two flagella that reach a little beyond the extremity of the rostrum.

The second pair of antennæ carries a scaphocerite that is about the same length as the rostrum, and terminates in a flagellum that is subequal with the length of the animal.

The first pair of gnathopoda is short, but tolerably robust.

The second pair has the basis and ischium compressed, the former is broad and slightly produced anteriorly on the inner margin, while the outer margin carries a branch that is half the length of the succeeding joint or ischium, which is broad at the base and gradually narrowed towards the distal extremity, and as it narrows is correspondingly strengthened by an upwardly curved edge on the outer margin, which is fringed with a row of hairs on its inner side.

The first pair of pereiopoda is slender, and carries a long-fingered chela. The second pair is more robust and longer. The three succeeding pairs are moderately strong, have the carpos subequal in length with the propodos, and terminate in a short, curved dactylos that is serrate on the inner margin.

The pleopoda in both sexes closely resemble those of *Campylonotus semistriatus*, those of the first pair have the branches unequal, the outer being small and foliaceous in the female, but filamentous in the male, while the inner is more membranous in the male than in the female.

The posterior pair, which helps to form the rhipidura, is subequal in length with the telson. The diæresis is one-third the length of the plate from the distal extremity, and is protected by a single tooth on the outer margin.

Observation.—There was only one female of this species taken that was laden with ova, which were numerous and of moderate size.

Campylonotus vagans, n. sp. (Pl. CXXII. fig. 3).

Carapace anteriorly carinated and produced to a rostrum that is longer than the carapace, armed on the gastric and frontal regions with four large teeth, of which the anterior two stand on the base of the rostrum, which is otherwise quite smooth to the apex except for two small subapical points; the under margin is armed with eight teeth. The first antennal tooth is well defined, but the second is only determined by a short ridge.

The pleon is smooth; the third somite is arcuate and produced posteriorly over the fourth; the sixth somite is short.

The telson tapers to a truncated point.

Length, entire,	83	mm.	(3·2 in.).
„ of carapace,	22	„	
„ of rostrum,	33	„	
„ of pleon,	61	„	
„ of third somite of pleon,	14	„	
„ of sixth somite of pleon,	9	„	
„ of telson,	12·5	„	

Habitat.—Station 308, January 5, 1876; lat. 50° 8′ 30″ S., long. 74° 41′ 0″ W.; off Tom Bay, Patagonia; depth, 175 fathoms; bottom, blue mud. One specimen, female. Trawled.

The carapace is about one-third of the length of the animal, and is anteriorly produced to a laterally compressed rostrum that is once and a half as long as the carapace. The dorsal surface is carinated over the gastric region and armed with two large teeth, one on the pyloric and the other on the gastric region, and two others, equally distant from each other, stand on the base of the rostrum, from the anterior tooth of which the rostrum is smooth to near the apex, which is gradually curved upwards and furnished near the extremity with two very small teeth. The under margin is largely excavate near the ophthalmopoda, where it is very deep, and gradually narrows to the apical extremity, and is armed with a series of eight teeth gradually decreasing in size anteriorly. The frontal margin has no orbital tooth; the first antennal is well developed, but the second antennal is small and the fronto-lateral angle is rounded off. The rest of the carapace is smooth, but evidences of lateral carinæ exist in a rudimentary condition, corresponding with the first and second antennal teeth.

The pleon is dorsally smooth, excepting that the third somite, which is longer than any of the others, projects posteriorly over the fourth. The three anterior somites have the postero-lateral angle rounded, the fourth has it slightly angular, the fifth has it sharply angular, and the sixth, which is longer than the fifth, is posteriorly produced to a sharp tooth, anterior to which there is a deep excavation to receive the sixth pair of pleopoda.

The telson gradually tapers to a rounded apex, the dorso-lateral angles being armed with three small equidistant spinules.

The ophthalmopoda are short and pyriform.

The first pair of antennæ (fig. 3*b*) has the first joint of the peduncle excavate on the upper surface, and furnished with a long stylocerite that reaches beyond the extremity of the first joint; the two succeeding joints are together shorter than the first, cylindrical, and unequal, the third being the shorter; the flagella are nearly equal in length and shorter than the rostrum.

The second pair of antennæ (fig. 3*c*) carries a long and gradually narrowing scaphocerite, the extremity of which is armed with a strong tooth; the flagellum is broken off at less than the length of the rostrum.

The mandibles (figs. 3*d*, 3*d'*) have a broad and bluntly serrate psalistoma, the anterior angle of which consists of a large tooth, and the whole is continuous with the molar tubercle, which is smooth on the anterior and coarsely serrate on the posterior margin; from the outer angle a two-jointed synaphipod arises which carries a strong bunch of short hairs at the base, and similar hairs also stud the distal spatuliform joint.

The first pair of siagnopoda (fig. 3*e*) is three-branched; the inner branch is short, rounded, and fringed with soft hairs and a few stout spines; the second or middle branch is broad, wider at the distal margin than at the base, and fringed with two or three rows of strong spines; the third or outer branch is short, curved, and bifid, one extremity carrying a single fringed hair and the other several hairs.

The second pair of siagnopoda (fig. 3*f*) is four-branched, and carries a mastigobranchial plate that extends backwards as a long and narrow process, fringed on the inner side with long hairs that reach to the posterior extremity of the branchial chamber. The other branches are short, foliaceous, and fringed with hairs.

The third pair of siagnopoda (fig. 3*g*) is three-branched, and carries a bilobed mastigobranchia ; the inner branch is broad, foliaceous, and fringed with fine hairs, the middle branch is triarticulate and fringed with fine hairs, the third or outer is broad and foliaceous at the base and suddenly narrows distally to a long and tapering flagellum fringed with hairs.

The first pair of gnathopoda (fig. 3*h*) is subpediform and seven-jointed ; the propodos is broad and reflexed ; the basis carries a long and slender ecphysis and the coxa supports a short membranous mastigobranchia without a branchia, but a short arthrobranchial plume is attached to the membranous articulation.

The second pair of gnathopoda (fig. 3*i*) is long, slender, and pediform. The coxa carries a short and rigid mastigobranchia, armed with a small hook but without a podobranchial plume, but an arthrobranchia is attached to the membranous articulation ; the basis carries a well-developed but not long ecphysis, and the distal joints are fringed with minutely ciliated hairs.

In the only specimen all the pereiopoda were broken off previously to my finding it among a number of specimens of *Campylonotus semistriatus*, excepting one of the third and one of the fifth pairs on the right side ; these are moderately long, tolerably robust, and terminate in a short and simple unguiculate dactylos.

The pleopoda are biramose, the first pair has the rami unequal, the inner being the shorter. The others are subequal and the inner branch carries a stylamblys.

The rhipidura is well developed, the lateral plates being longer than the telson, and the outer has a diæresis.

Observations.—A careful comparison of this species with others of its own genus, and of *Chorismus* and *Merhippolyte*, is instructive as throwing light upon the mysteries of specific variation.

If we compare the external form of *Campylonotus vagans* with that of *Chorismus tuberculatus*, we perceive that it corresponds more nearly to it than to its generic ally *Campylonotus semistriatus*. The only external distinction between them that may be considered to be specific is that *Campylonotus vagans* has the sixth somite of the pleon comparatively longer, and there is a prominence on the anterior margin of the first and on the posterior margin of the fourth somites of the pleon, but an examination of the branchial apparatus shows that, while *Chorismus* has only seven branchial plumes on each side, *Campylonotus* has twelve, and in this respect agrees with *Merhippolyte*.

Had the solitary specimen of *Campylonotus vagans* been a perfect one there would have been little difficulty in determining its generic position, but the first two pairs

of pereiopoda being broken off, we can only be certain whether it belongs to the Polycarpidea or the Monocarpidea by consideration of the value of certain structural details. Thus the mandibles agree with those of *Campylonotus* and differ from those of *Chorismus* and *Merhippolyte*. The ventral surface of the pereion corresponds generically with *Campylonotus*, although it differs specifically from *Campylonotus semistriatus* in having a pair of teeth between the second pereiopods only, whereas in *Campylonotus semistriatus* there is a pair between the first as well as the second pair of limbs, but in *Chorismus* and *Merhippolyte* there are none. On these grounds it seems more likely to belong to the Monocarpidea than to the Polycarpidea.

Our specimen was a solitary one among a large number of *Campylonotus semistriatus*.

Palæmon, Fabricius.

Palæmon, Fabricius, Suppl. Entom. Syst., p. 402.
„ Leach, Malacos. Pod. Brit., pl. xiv.
Palemon, Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 387.
Leander, Desmarest, Ann. Soc. Entom. France, tom. vii. sér. 2, p. 87, 1849.
„ Stimpson, Proc. Acad. Nat. Sci. Philad., p. 109, 1860.

Carapace less than a third the length of the animal, posteriorly smooth, rounded, slightly compressed anteriorly, elevated into a crest over the frontal region, and produced to a long, laterally compressed rostrum that is armed above and below with teeth varying in number according to the species. The orbital notch is well defined, but has no tooth. At the outer canthus a strong first antennal tooth projects; below it and still further down a second tooth stands within the margin on a level with the second pair of antennæ, and above the line of the fronto-lateral angle ("spina branchiostegiana" of Stimpson). There is no tooth on the hepatic region, but a depression or fissure thence to the upper side of the inferior marginal tooth is conspicuous.

The pleon is smooth, and like the carapace dorsally rounded and laterally compressed.

The telson is similarly characterised, tapers gradually to a central tooth, and is furnished with dorso-lateral spines.

The ophthalmopoda are short, broad, uniarticulate, and supported on a slender pedicle; the ophthalmus is hemispherical, and has an ocellus that is sometimes distinct, but in the typical species is involved within its margin.

The first pair of antennæ has the first joint compressed above and beneath, and armed on the outer margin with a sharp, short stylocerite, and at the anterior distal angle with a strong flattened tooth; the second joint is thicker than the first, shorter on the upper surface than on the lower, and articulates obliquely with the third

joint, which terminally supports two long flagella, of which the upper and outer sends off a third that is shorter than the others.

The second pair of antennæ is armed with a tooth at the outer and lower distal angle of the first joint of the peduncle, carries a scaphocerite that is about two-thirds the length of the carapace, and terminates in a long flagellum.

The mandible consists of a strong molar process projecting at right angles with the apophysis, and separated from a strongly dentate psalistoma, at the outer side of the base of which stands a three-jointed synaphipod of considerable tenuity.

The second pair of gnathopoda is pediform, having only three joints exposed, of which the terminal is the shortest and ends in an obtuse point, and the basis carries a rather slender ecphysis.

The first pair of pereiopoda is slender and chelate, the carpos being long, slender, and uniarticulate. The second pair of pereiopoda resembles the first in form, but is longer and larger, and has the carpos uniarticulate. The three following pairs resemble each other in form and proportions, and approach in length that of the second pair; the dactylos is uniunguiculate, the propodos long and cylindrical, and the carpos has the anterior distal angle produced beyond the carpal joint of the propodos.

The pleopoda are robust, foliaceous and biramose.

The rhipidura has the outer branch with a diæresis.

The branchiæ consist of seven pairs arranged as in the following table:—

Pleurobranchiæ,	...	...	1	1	1	1	1
Arthrobranchiæ,	...	1	...	...	...	...	...
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	r	...	...	...	...	...	...
	h	i	k	l	m	n	o

Observations.—This genus was first founded by Fabricius, in 1798, for those species of Macrura that had "four, unequal, pedunculated antennæ. The first (superiores) pair the shorter, trifid, setaceous, the middle branch being the shortest (lacinia intermedia breviore). The second (inferiores) antennæ very long, setaceous, and simple."

In his list the following species and habitats are given:—

"*Palæmon carcinus*, American Rivers.
Palæmon lar, East India.
Palæmon longimanus, East India.
Palæmon brevimanus, East India.
Palæmon coromandelianus, East India.
Palæmon tranquebaricus, East India.
Palæmon squilla, European Seas.
Palæmon locusta, Ocean.
Palæmon serratus, Norwegian Sea.
Palæmon fucorum, Ocean weed."

Of these *Palæmon carcinus*, *Palæmon squilla*, and *Palæmon locusta* appear in Linnæus' Systema Naturæ under the general carcinological name of "*Carcinus*,"

while *Palæmon serratus* was described and figured under the name of *Astacus serratus*, in 1770, by Pennant, in his British Zoology, vol. iv. pl. xvi. fig. 28.

This well-known European form, *Palæmon serratus*, has ever since been accepted as typical of Fabricius' genus by Cuvier, Leach (1817), Desmarest (1825), Milne-Edwards (1837), and Bell (1853); and Leach, Desmarest, and Bell have, besides their descriptions, given accurate figures of the animal.

Its chief characteristics are as follows :—A laterally compressed rostrum, serrate on the upper and lower margins ; the dorsal surface of the carapace not carinated posterior to the frontal crest ; the frontal margin armed with two teeth, one corresponding with the first pair of antennæ, and the other, close behind the frontal margin, corresponding with the second pair of antennæ ; the rest of the carapace smooth, the lateral margins being strengthened by a longitudinal rib, and the posterior margin laterally inserted beneath the coxal plates of the first somite of the pleon.

This description has been drawn up from a British specimen, and compared with the type in the British Museum, and it corresponds with the figures of Leach, Desmarest, and Bell.

I have endeavoured to be as accurate as possible in the diagnosis of this genus, because Dr. Stimpson [1] describes the *Palæmon* of Fabricius as "Carapax spina hepatica armata." This description corresponds with *Palæmon carcinus*, Fabricius, but not with either *Palæmon serratus* or *Palæmon squilla*. The figures of Leach, Desmarest, and Bell distinctly show the two marginal teeth, and Milne-Edwards, in his description of his first division of *Palæmon*, places the two marine species just mentioned under it because "they are armed on the anterior border of the carapace on each side with two teeth, one above, the other below the insertion of the second (externes) pair of antennæ."

Surely all this is sufficiently clear in description and priority to settle that the typical forms of the genus are *Palæmon squilla* and *Palæmon serratus*.

By the expression "species omnes fluvicolæ," it would appear that Stimpson intended to confine the genus to those fresh-water forms that have been found in many of the rivers, lakes, and mountain streams in tropical regions, and which Milne-Edwards has arranged in his second division of the genus, having the frontal margin of the carapace armed with a single tooth, but with a second tooth posterior to it in the same horizontal line.

Dr. Stimpson altogether excludes the typical species, or those on which the earlier carcinologists founded the genus, but transfers them to the genus *Leander*, which was proposed by Eugène Desmarest on features that are not of the slightest specific value, namely, on the dorsal surface of the pleon being strongly curved, or, to quote his own words :—"L'*abdomen* est très grand, et se rétrécit graduellement vers le bout ; sa

[1] *Proc. Acad. Nat. Sci. Philad.*, p. 110, January 1860.

face supérieure est fortement *arquée* et comme *bossue*," which the following table represents :—

Palémoniens : Ayant les ant. int. terminees par	Trois filets multiarticulés.	Pattes de la deuxième *paire* filiformes et à carpe multiarticulé,		*Lysmata.*
		Pattes de la deuxième *paire* plus fortes que les antérieures, et n'ayant pas le carpe devisé	Abdomen bossu en dessus,	*Leander.*
			Abdomen non bossu en dessus,	*Palæmon.*

Stimpson accepted the genus *Leander* of Desmarest, but established it upon totally different characters from those of the author.[1] His words are :—"Genus *Leander*, E. Desmarest. Carapax spina antennali et spina branchiostegiana armatus ; spina hepatica nulla, species plerumque maricolæ. Typus *Palæmon natator* M. Edwards."

This will be seen to correspond with the description of *Palæmon*, which has the "spina branchiostegiana" and has no "spina hepatica," according to Leach's type still preserved in the British Museum.

Synopsis of the Genera included in the original Genus Palæmon *of Fabricius.*

Palæmon,	Rostrum deep, serrate above and below.	Having the frontal margin of the carapace armed with two antennal teeth, one above the other. Second pair of pereiopoda with carpos long. Type, *Palæmon serratus* (Pennant) and *Palæmon squilla* (Linné).
Palæmonella, 1852,	Rostrum slender, serrate above and below.	Having one tooth on the frontal margin, and a second on the hepatic region in nearly the same horizontal line. Second pair of pereiopoda with carpos not long. *Palæmonella tenuipes*, Dana.
Bithynis, 1836,	Rostrum deep, serrate above and below.	Having one tooth on the frontal margin, and a second on the hepatic region nearly in the same horizontal line. Second pereiopod with the carpos long. Type, *Bithynis lar* (Fabricius).
Brachycarpus, n. gen.,	Rostrum deep, serrate above and below.	One tooth on the frontal margin, and a second on the hepatic region, below the horizontal line. Second pereiopod with the carpos short. Type, *Brachycarpus savignyi* (Pl. CXXIX.).

Palæmonella, *Bithynis*, and *Brachycarpus* can only be considered as varieties of *Palæmon*, yet they are such decided forms that they may be easily distinguished.

Geographical Distribution.—The species of this genus as defined in this Report are among the best known of the European species, and form one of the most favourite delicacies of the table.

Most of the species recorded by Milne-Edwards are from the coasts of Europe, but *Palæmon quoianus* is from New Zealand, *Palæmon natator* is found in the Indian Ocean, and has since been found in the middle of the Atlantic upon floating weed.

[1] *Loc. cit.*, p. 109.

Palæmon longirostris comes from the mouth of the Ganges, *Palæmon vulgaris*, Say, belongs to North America, and *Palæmon tenuirostris*, Say, to the coast of Newfoundland.

Under the name of *Leander* Stimpson records several species from the coasts of China and Japan, and one from Australia.

Palæmon affinis, Milne-Edwards (Pl. CXXVIII. fig. 5).

Palemon affinis, Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 391.
Palæmon affinis, Dana, U.S. Explor. Exped., Crust., p. 584, pl. xxxviii. figs. 5*a*–*g*.

Closely resembles *Palæmon squilla* of Fabricius (the *Cancer squilla* of Linnæus and most European authors), and only appears to be recognisable from that species in having the apex of the rostrum bifid and four teeth instead of three on the under margin. The specimen from which Milne-Edwards defined the species was not sufficiently preserved to enable him to give a complete description. But Dana has been more fortunate and says that "Although very near to the *P. squilla*, the coalesced flagella of the inner antennæ are united to a longer distance from the base of these organs."

	Male.	Female.
Length, entire, . . .	24 mm. (0·9 in.).	33 mm. (1·3 in.).
„ of carapace, . .	6·5 „	10 „
„ of rostrum, . .	6·5 „	9 „
„ of pleon, . .	17·5 „	23 „
„ of third somite of pleon, .	5 „	5 „
„ of sixth somite of pleon,	4 „	4 „
„ of telson, . .	5 „	6·5 „

Habitat.—Port Jackson, Sydney, June 1874. Sixteen specimens; eight males and eight females, the latter bearing ova.

The carapace is less than one-third the length of the animal, it is crested over the frontal region and anteriorly produced to a rostrum that is equal to the length of the dorsal surface of the carapace, bifid at the apex, and armed on the upper margin with seven teeth, the posterior being on the gastric region and the anterior a little distance from the apex, and on the lower margin with four teeth, the distal being the smallest and nearer the apex than the corresponding tooth on the upper margin. The orbit is defined by an angle on the inner side of the first antennal tooth, below which on the receding frontal margin stands the second antennal tooth; the surface of the carapace is otherwise smooth.

The pleon is dorsally rounded and laterally compressed, the third somite, being slightly arcuate, projects posteriorly above the fourth, which with the two succeeding is considerably narrower in the female. The sixth somite is but little longer than the

preceding, and rather shorter than the telson, which is dorsally rounded and gradually tapers to the extremity; on each side within the margin are three small spinules, and the distal extremity is fringed with a few hairs.

The ophthalmopoda (fig. 5*a*) are short and robust; the ophthalmus is but little broader than the stalk, and furnished beyond the margin of the ophthalmus with a minute, round ocellus. In this it differs from the European type of the genus, which has the ocellus enclosed within the margin of the ophthalmus instead of being isolated.

The first pair of antennæ has the basal joint of the peduncle so deeply excavate on the upper surface for the reception of the ophthalmopod, that the appendage is translucent in the centre; the outer margin is furnished with a sharp-pointed stylocerite that is about half the length of the joint, at the distal extremity of which, on the same side, is another sharp flat point or tooth; the second and third joints are short, cylindrical, and fringed with fine short hairs, and terminally support two flagella, the inner of which is long and slender, while the outer is stout and flat as far as a point equal to the length of the peduncle, when it divides into two slender branches, the inner being short and rigid, the outer long, slender, flexible, and subequal with the inner flagellum. It is remarkable that neither of the flagella of this pair of antennæ has attached to it any of the membranous cilia so common in the order.

The second pair of antennæ is furnished with a broad scaphocerite that reaches to the extremity of the rostrum, and a slender flagellum that is rather longer than the body of the animal.

The mandible (fig. 5*d*) consists of a stout molar process, a separate psalistoma that is serrate at the extremity with four teeth, of which the two middle ones are the smaller, and on the outer side, at the base, a slender three-jointed synaphipod that does not reach to the length of the psalistoma.

The second pair of gnathopoda (fig. 5*i*) is short, not reaching much beyond the ophthalmopoda; it is five-jointed; the coxa supports a small podobranchia, and the basis a short ecphysis; the three following joints are thickly furred with hairs, the terminal ending in an obtuse point.

The first pair of pereiopoda is long and slender, the carpos being twice the length of the propodos. The second pair is long and slender, the carpos being nearly as long as the palm of the propodos, and the chela about half the length of the palm. The succeeding three pairs are subequal, and fringed with small hairs; the carpos is anteriorly produced beyond the near extremity of the propodos, which is cylindrical and terminates in a slightly curved, sharp-pointed dactylos.

The pleopoda are biramose, the inner distal angle of the basal joint projecting beyond the articulation with the branches.

The ova attached to the females are small, numerous, and round, and appear to have the embryo generally well advanced in development.

The terminal pair, which helps to form the rhipidura, is a little longer than the telson, and has a diæresis armed on the outer margin with a well-defined tooth.

Observation.—It is interesting to notice the close approximation of this species to *Palæmon squilla*, the habitats being the antipodes of each other.

Palæmon natator, Milne-Edwards (Pl. CXXVIII. figs. 6, 7).

Palæmon natator, Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 393.
Leander erraticus, Desmarest, Ann. Soc. Entom. France, tom. vii. sér. 2, p. 87, 1849.
Leander natator, Stimpson, Proc. Acad. Nat. Sci. Philad., p. 109, 1860.

Male.—Carapace about one-third the length of the animal and anteriorly produced to a rostrum that is subequal in length to the carapace, and armed on the upper margin with nine or ten teeth and on the lower with six; frontal margin armed with an antennal and a branchiostegal tooth.

The pleon has the third somite longer than the others, dorsally arcuate, and projecting posteriorly in the median line over the succeeding somite.

The ophthalmopoda are robust and largely project beyond the pedicular attachment; the ophthalmus is hemispherical, and is furnished with a distinct ocellus on the posterior surface, in contact with the margin.

The first pair of antennæ has the flagella long and slender, the upper and outer being nearly as long as the animal, and the inner and lower about two-thirds the length of the outer; the third or secondary branch of the outer is about half the length of the inner, much stouter than either of the two, and continues the same almost to the extremity; the first joint of the peduncle is longer than the second and third together, it is broadly dilated, of great tenuity, and armed with a stylocerite that reaches to half its length, and a sharp-pointed tooth on the outer distal angle; the third and fourth joints are cylindrical and short.

The second pair of antennæ is as long as the animal and has the flagellum as slender as those of the upper; it carries a scaphocerite that is equal in length to the rostrum or carapace, and armed on the outer distal angle with a sharp tooth, whence the anterior foliaceous margin advances obliquely forwards beyond the apex of the external tooth; the inner margin is subparallel with the outer, and the basal joint is armed with a strong, sharp tooth near the base of the scaphocerite.

The mandible resembles that of *Palæmon serratus* in character, but has the molar process more strongly dentate and the psalistoma broader and strongly serrate; the synaphipod is shorter than the psalistoma and of extreme tenuity.

The succeeding oral appendages are of generic value only, and closely resemble those of *Palæmon serratus*.

The first pair of gnathopoda carries a very rudimentary mastigobranchial appendage and a small podobranchial plume.

The second pair of gnathopoda has the antepenultimate joint, which I take to be the ischium and meros united, deeply arched downwards; the basis is furnished with an ecphysis that reaches to the distal extremity of the meros, and connected with the appendage is a small branchial plume that appears to be attached to the coxal articulation, and is, therefore, arthrobranchial in character.

The first pair of pereiopoda is slender, chelate, and extends to a point subequal with the apex of the rostrum; the fingers are longer than the palm, and the carpos is as long as the propodos, including the palm and dactyloid process. The second pair is longer and more robust than the first; it is chelate and has the fingers longer than the palm, which is subcylindrical, and subequal in length with the carpos. The three succeeding pairs are uniform in size and character; the meros is longer than the ischium, the carpos is a little more than half the length of the meros and projects at the anterior distal angle over the propodal articulation; the propodos is twice the length of the carpos, and is furnished with several solitary spines on the anterior and posterior margins; the dactylos is curved, smooth, and uniunguiculate.

The branchiæ correspond in arrangement with those of *Palæmon serratus*.

Female.—Differs from the male in being shorter and more robust generally, and in having the rostrum shorter in proportion to the length of the carapace, and deeper anteriorly, assuming more the shape "*d'un fer de lance*" mentioned by Milne-Edwards.

	Female.	Male.
Length, entire, ...	23 mm. (0·9 in.).	26 mm. (1 in.).
„ of carapace, . . .	6 „	7 „
„ of rostrum, . . .	7 „	8 „
„ of pleon, ...	17 „	19 „
„ of third somite of pleon, . .	4 „	5 „
„ of sixth somite of pleon, . .	3 „	3·5 „
„ of telson, ...	4 „	5 „

Habitat.—Gulf-weed, Atlantic, April 1873. One hundred and thirteen specimens, females rather preponderating.

The original specimen from which Milne-Edwards drew up his description was found in the Indian Ocean, upon some floating weed. Desmarest obtained his specimen (*Leander erraticus*) from the Atlantic, at about 100 to 150 leagues off the coast of Guadeloupe. Dr. Stimpson's specimen, which he takes to be the same as *Leander* of Desmarest, was found to be common amongst the Sargasso-weed in the Atlantic, between 30° and 35° north of the equator.

It was from this region that the specimens in the Challenger collection were also taken, and they correspond both generally and in detail with the description given by Milne-Edwards, excepting that they have nine teeth on the upper surface of the rostrum in the male, and four on the lower margin, and twelve on the upper margin in the

female, and six on the lower; but, as Milne-Edwards' specimens were obtained from floating weed in the Indian Ocean, the two sexes in that region may more closely resemble each other in their ornamentation, and thus the rostrum may have eleven teeth on the upper margin of the rostrum and be scarcely dentate at all on the lower. The serrature in our typical specimens is not very strong, and in many it is feeble enough to fulfil the description of Milne-Edwards.

Desmarest describes and figures his species, *Leander erraticus*, as being strongly dentate above and "au contraire sans dents en dessous." In all other features both the figure and the description correspond with *Palæmon natator*, Milne-Edwards, and it is probably a variety in which the armature on the lower margin of the rostrum is more than usually undefinable.

Palæmonella, Dana.

Palæmonella, Dana, U.S. Explor. Exped., Crust., p. 582.
„ Kingsley, Proc. Acad. Nat. Sci. Philad., p. 425, 1879.

Resembles *Palæmon*, but has the rostrum long, thin, and slender, the first two pairs of pereiopoda chelate, the second one longer than the first. Mandibles furnished with a two-jointed synaphipod. Two of the flagella of the first pair of antennæ united nearly to their tips.

The carapace is furnished with two teeth below the orbit, in nearly the same horizontal line.

The second pair of gnathopoda is slender, as in *Palæmon*.

The first pair of pereiopoda is very slender. The second pair is moderately robust, with the hand nearly cylindrical, and hardly stouter than the preceding part of the leg.

The foregoing is a close transcription of Dana's diagnosis of the genus. Kingsley[1] appears to determine the genus as distinct from *Palæmon* by the synaphipod being biarticulate, and the first pair of antennæ biflagellate, one flagellum having the apex bifid; he says that in *Palæmon* it is triflagellate, which is not the case, as may be seen in the typical species as well as in *Palæmon affinis* (p. 783).

Observations.—There is but a single specimen, and that a young one, in the Challenger collection, and I therefore have not had an opportunity of examining the oral appendages in detail; but I accept the genus on the character of the mandibles, the form of the rostrum, and the presence of a hepatic tooth on the carapace, as given by Dana and Kingsley.

Geographical Distribution.—There are but two species known, and these were both taken in the Oriental seas.

[1] *Loc. cit.*, p. 425.

Palæmonella orientalis, Dana (Pl. CXXVIII. fig. 4).

Palæmonella orientalis, Dana, U.S. Explor. Exped., Crust., p. 582, pl. xxxviii. figs. 4*a–d*.

Carapace less than one-third of the length of the animal, anteriorly produced to a slender rostrum, that is armed on the upper surface with six teeth and on the lower with a small tooth near the apex.

Pleon smooth.

Telson long, narrow, and tapering.

Length, 5 mm. (0·2 in.).

Habitat.—Station 200, October 23, 1874; lat. 6° 47′ N., long. 122° 28′ E.; off Sibago, Philippine Islands; depth, 250 fathoms; bottom, green mud. One specimen; probably taken at or near the surface. Trawled.

The carapace is smooth and anteriorly produced to a rostrum that is subequal in length with the dorsal surface of the carapace; it is armed above with six equidistant teeth, the posterior of which is above the orbital margin and the anterior close to the apex of the rostrum, and below with one small tooth near the distal extremity, the rest of the lower margin being smooth and parallel with the upper; beyond the orbit on the frontal margin is a first antennal tooth, and, according to Dana, another tooth is situated in nearly the same parallel line, and therefore must be the hepatic tooth.

The pleon is smooth and the somites subequal, the sixth being longer than the preceding, and the telson subequal in length with it.

The ophthalmopoda are pyriform and rather large.

The first pair of antennæ is furnished with a short stylocerite, has the peduncle subequal in length with the rostrum, and supports two moderately robust flagella, the outer of which after two rather large articuli divides into two unequal branches, the longer about half the length of the animal, the shorter about one-fourth the length of the other, but more robust, and supporting a series of membranous or sensory cilia.

The second pair of antennæ is subequal in length with the animal, and supports a scaphocerite that reaches beyond the distal extremity of the rostrum.

The second pair of gnathopoda is short, five-jointed, and furnished with a basecphysis that reaches as far as the carpal articulation; the terminal two joints are more slender than the preceding and fringed with hairs, of which those at the distal extremity are stiff and spine-like (fig. 4*i*).

The first pair of pereiopoda is long, slender, and chelate. The second pair is longer, larger, and similarly formed. The three succeeding pairs are subequal in length, moderately robust, and have the carpos distally produced beyond the propodal articulation; the propodos is cylindrical, slightly curved, and fringed with small fasciculi of hairs; the dactylos is curved and terminates in two unequal ungues.

The pleopoda and rhipidura correspond with those of the genus *Palæmon*.

Observations.—The solitary specimen in the collection is only about a third of the length of that described by Dana, but it appears to have its parts completely developed. It corresponds so closely with the description of Dana's species that I have no doubt of its identity with it, and I attribute certain differences to the young condition of the specimen under examination; but it is difficult to completely examine it without injuring it. In the Challenger specimen the ophthalmus is much larger in proportion than in Dana's figure, and, with the utmost care, I have not been able to detect the hepatic tooth on the carapace, nor has Dana shown it in his figure or alluded to it in his description of this species, although he mentions it in his generic diagnosis. The dactylos of the posterior three pairs of pereiopoda is biunguiculate, a fact that is overlooked by Dana.

Bithynis, Philippi.

Bithynis, Philippi, Wiegmann's Archiv f. Naturgesch., Jahrg. xxvi. p. 161, 1860.
Macrobrachium, Spence Bate, Proc. Zool. Soc. Lond., p. 363, 1868.
Palæmon (pars), Dana, U.S. Explor. Exped., Crust., p. 584.
„ Stimpson, Proc. Acad. Nat. Sci. Philad., p. 110, 1860.
„ (Division 2), Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 395.

Like *Palæmon*, but differing in having a tooth on the hepatic region and no tooth corresponding with the second antennæ (the "spina branchiostegiana" of Stimpson), in having the carpos of the second pair of pereiopoda long and cylindrical, and this appendage developed in the adult to a greater length than that of the entire animal, and more or less unequal, and in having the pleon shorter in proportion to the length of the carapace.

Geographical Distribution.—Species of this genus are more or less present in the fresh-water streams of tropical Asia, America, and Africa; when they have been taken in the sea it has been only at the mouths of the rivers they are found to inhabit.

Mr. Kingsley[1] says that this form is far from being uncommon in salt water, and instances several species, as *Bithynis spinimanus*, *Bithynis grandimanis*, *Bithynis jamaicensis*, *Bithynis forceps*, &c. Milne-Edwards says that *Bithynis ornatus*, *Bithynis carcinus*, and other long-armed forms are found in different parts of the Indian Ocean, and that *Bithynis jamaicensis* inhabits the Antilles.

There is undoubtedly a peculiarity belonging to this group that distinguishes it at once from the typical form of *Palæmon*, and although there is evidence of specimens having been taken in the sea, yet in several instances they are supposed to be marine, because the locality to which they belong has been alone recorded, without any special notice of their having been found in fresh water as their normal habitat. *Bithynis*

[1] *Bull. Essex Inst.*, vol. x. p. 66.

jamaicensis was first described and figured by Sir Hans Sloane[1] in 1725, and again by Parra in 1787, as "*Camaron de agua dulce.*" Dr. Leach refers to it under the name of *Palæmon carcinus*,[2] and states that it lives in fresh water, and Mr. Osbert Salvin[3] has obtained it from Lake Amatitlan, where it reaches a large size and forms an important article of commerce in the market at Guatemala. Dr. Semper[4] says that in the British Museum there are numerous specimens of different sizes from Brazil, West Indies, Surinam, British Guiana, Bahia, and the Cape Verde Islands, and that those from Surinam and British Guiana came from fresh water.

Bithynis (*Palæmon*) *ornatus*, which Milne-Edwards says has been found in different places in the Indian Ocean, inhabits the East Indies, the Mollucca and Philippine Islands, Australia, and the Fiji Islands, and has been taken in fresh-water rivers in these regions; whereas *Bithynis grandimanus*, a small but not very dissimilar species, exists in fresh water in the Society Islands, and supplies the markets of Honolulu. Hilgendorf[5] records three specimens of *Bithynis* (*Palæmon*) *idæ*, Heller, from Zanzibar, and remarks "that until now this species was only known as a fresh-water species from the Indian Archipelago. The large extent of geographical distribution is very remarkable."

Bithynis (*Palæmon*) *hirtimanus*, Oliver, has also been obtained in the Mauritius, and Heller[6] records several species from the Australasian group which appear to be young forms, since they possess all the characters of the genus except the great length of the second pair of pereiopoda—*e.g.*, *Bithynis* (*Palæmon*) *spectabilis*, *Bithynis* (*Palæmon*) *scabriculus*, *Bithynis* (*Palæmon*) *superbus*, and *Bithynis* (*Palæmon*) *sinensis*.

Bithynis lar (Fabricius) (Pl. CXXIX. fig. 1).

Palemon lar, Fabricius, Suppl. Entom. Syst., p. 402.
„ „ Olivier, Encyclop., tom. viii. p. 659.
„ „ Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 397.

Carapace more than one-third the length of the animal, dorsally rounded, anteriorly crested and produced to a rostrum that is about half the length of the carapace, laterally compressed, and traversed by a ridge on either side from the orbital margin to the apex; it is armed on the upper margin with eight teeth, of which the posterior is on the gastric region, and the anterior near the apex, and in the space between each two teeth is a

[1] Voyage to the Island of Madeira, vol. ii. p. 271, pl. ccxlv. fig. 2.
[2] *Zool. Misc.*, vol. ii. p. 92, pl. xcii.
[3] On a new genus, with four new species, of Fresh-water Prawns, by C. Spence Bate; under the name of *Macrobrachium americanum*, *loc. cit.*, p. 364.
[4] *Proc. Zool. Soc. Lond.*, p. 585, 1869.
[5] Crustaceen in V. d. Decken's Reisen in Ost-Afrika, Bd. iii., p. 102, Tab. vi. fig. 5, 1869.
[6] Reise der Novara, Zoolog. Theil., Bd. ii., Crust., pp. 113, 117, 118, 119, 1868.

series of ciliated hairs that are generally worn off, excepting where the projecting tooth protects it. The lower margin is furnished with two teeth which are situated near the middle, between the orbit and the apex of the rostrum, and the whole edge is fringed with small hairs. The orbit is defined at the outer canthus by a prominent rounded lobe, beyond which stands a conspicuous antennal tooth, and behind and beneath it a conspicuous hepatic tooth. The fronto-lateral angle is rounded and unarmed.

The pleon is dorsally rounded and laterally compressed. The third somite is not longer than the second and is not arcuate, and the sixth somite is but a little longer than the fifth.

The ophthalmopoda stand upon a short pedicle; the ophthalmus is hemispherical, and has a small ocellus beyond the margin.

The first pair of antennæ is nearly as long as the second, and two-thirds the length of the animal; the first joint is excavate to receive the ophthalmopod, and has the margin fringed with hairs, those on the anterior wall of the excavation being directed posteriorly; the stylocerite is short, and so closely impacted against the margin of the joint that it ceases to be an offensive weapon; the outer distal angle is armed with a strong but short tooth; the second and third joints are subcylindrical, and articulate with each other obliquely, the inner distal angle of the second joint being produced on the under surface nearly to the extremity of the third joint. The outer flagellum is stout at the base and soon sends off a secondary branch that is slender, and as long as the inner flagellum.

The second pair of antennæ is longer than the animal and supports a large scaphocerite that reaches to the extremity of the rostrum, it is armed on the outer side with a tooth that is closely impacted into the margin, and does not reach to the extremity of the appendage. The base of the peduncle is armed on the outer and lower angle with a strong tooth, above which is a lobe, and between this and the tooth there is a groove into which the scaphocerite falls when projected backwards.

The oral appendages correspond with those of *Palæmon serratus*.

The first pair of gnathopoda closely resembles that of *Palæmon*.

The second pair terminates in a sharp unguis and has the sides thickly furred with short, stiff hairs, and the coxa bears a short and broad calcified process.

The first pair of pereiopoda is slender, and when extended reaches considerably beyond the apex of the rostrum; it is chelate, the pollex and dactylos being nearly as long as the palm of the propodos and impinging in their entire length, and furnished with numerous fasciculi of hair; the propodos is narrow, not broader than the carpos, and about half its length; the carpos is long, narrow, and cylindrical; the meros is three-fourths the length of the carpos, cylindrical, and slightly more robust; the ischium is short, about half the length of the meros, and on the inner side for nearly the entire length of the joint

there is developed a broad and slightly curved plate, the concave surface of which looks upwards, the margin being tufted with a thick mat of hairs; the basis is shorter than the ischium and like it has a flattened process, also tufted with hairs. These two processes form a point of support for the distal joints of the long appendage when reflexed and at rest. The limb being bent at the mero-carpal articulation, the lengths of the proximal and distal joints are equalised so that the chela when so bent reaches the mouth and is enabled to supply it with food. The coxa is short and robust.

The second pair of pereiopoda is extremely long and forms the distinguishing feature of this genus; it is about one-third longer than the entire animal, so that a specimen that measures 130 millimetres from the orbit to the extremity of the telson carries a pair of these limbs nearly 200 millimetres long. The coxa and basis are short, the ischium is longer and slightly compressed horizontally; the meros is twice the length of the ischium and subequal with that of the carpos; the propodos is twice and a half as long as the carpos, and the palm once and a half longer than the carpos; the pollex is subequal to the dactylos, cylindrical, and but very slightly larger in diameter than the distal extremity of the carpos, it is curved downwards in gradual continuation of the lower margin of the palm, and is armed on the inner surface near the base with two tubercles situated near together, the anterior being the larger and directed obliquely backwards.

The dactylos is long and slender, resembling the pollex, being slightly curved to correspond and lie parallel with it, it is armed on the inner surface about one-third from the articulation with a large flattened conical cusp, which with those on the pollex prevent the fingers from impinging close together, whereas the apices of the two pass each other when the chela is closed. The entire limb is finely granulated except on the dactylos and pollex, where the granulations are coarser and more pointed, and on the under surface of the propodos and carpos, where there are a few small tubercles.

The posterior three pairs of pereiopoda are short, subequal, furnished with hairs, and terminate in an unguiculate dactylos.

The pleopoda are biramose and subfoliaceous; the first pair has the inner branch pointed and half the length of the outer, all the others are subequal; the posterior pair helps to form the rhipidura, the outer branch of which is longer than the inner, and is divided by a diæresis, that is protected on the outer margin by a point that lies close against the distal portion of the plate.

The telson is one-third shorter than the outer ramus of the rhipidura and gradually tapers to an obtuse point; the dorsal surface is smooth and rounded, the distal half being dorso-laterally furnished with two equidistant solitary short spines, and the extremity is fringed on the under surface with a row of short stiff hairs, and at the outer angles on each side with a long and short spine.

Length, entire (male),	116 mm. (4·5 in.).
„ of carapace,	39 „
„ of rostrum,	25 „
„ of pleon,	77 „
„ of third somite of pleon,	13 „
„ of sixth somite of pleon,	13 „
„ of telson,	19 „

Habitat.—Tahiti. From a river at Papeuriri. Five specimens, full-grown males. Length, about 125 mm. (5 in.).

Kandavu and Ovalau, Fiji Islands. Twenty-three specimens; twenty-two males, one female. Length, male, 110 mm. (4·3 in.); female, 69 mm. (2·7 in.).

Pasananca, Mindanao, and near Samboangan, Philippine Islands. Five specimens; four full-grown males, and one female. Length, male, 125 mm. (5 in.); female, 78 mm. (3 in.).

Banda Island. Three specimens, females. Length, 52 mm. (2 in.).

Observations.—This species and that described by Olivier, under the name of *Palæmon ornatus*, are probably identical with that which Fabricius named *Palæmon longimanus*, and Milne-Edwards says that it has been taken at Amboina, Waigou, and several places in the Indian Ocean. A considerable number was brought home by the Challenger from the localities given above; and a close comparison of the numerous specimens leads to the conclusion that they all belong to the same species, although those from each locality show a variation in some unimportant feature that is peculiar to them alone.

Most of those procured from the river Papeuriri in Tahiti are about 125 mm. long, measured from the margin of the orbit to the extremity of the telson, and the long chelate second pair of pereiopoda is 275 mm. in length, or one-third longer than the animal.

The dorsal surface is of a purple colour, and it is probable that the whole animal may have been of a similar hue before it was placed in spirits, excepting probably the long arms, which are darker, the digital processes being almost black.

The finest specimen from Tahiti is rather larger, being 15 mm. longer and more robust, and the only trace of the purple colour that remains is to be found on the posterior margin of the teeth on the rostral crest. The long arms are of a brownish colour, deepening to a purple on the long, digital processes of the chela, and they are about 220 mm. in length. Those obtained at Ovalau and Kandavu are smaller, being only 110 mm. long, and not quite so robust. The chelate pereiopoda are about the same length, and of a brownish colour, the digital processes having the colour broken into spots. The purple hue still remains on the posterior margin of the teeth on the rostral crest.

The largest male specimen from Pasananca, Mindanao, Philippine Islands, is rather larger, being 128 mm. in length, and corresponds very nearly with the specimen from Ovalau, the most important distinction being in the size of the teeth on the rostral crest, which are somewhat larger and bolder. This is more apparent in some specimens than in others, and when the teeth are larger their number is reduced to six or seven, and when not so large, increased to seven or eight. In the specimens from this locality the chelate processes are more distinctly mottled.

The specimens from Banda are only three, and these are all small, the largest being only 52 mm. long; they are probably only young animals. I consider them to be of the same species as the preceding, but they differ in having the second pair of pereiopoda shorter in comparison, not being so long as the animal; the dactylos impinges in its entire length against the pollex, and there is no dental protuberance between them, a condition that pertains chiefly to full-grown animals.

Bithynis grandimanus (Dana) (Pl. CXXIX. figs. 2, 3).

Palæmon grandimanus, Dana, U.S. Explor. Exped., Crust., p. 588, pl. xxxviii. fig. 12.

Male.—Carapace four-fifths the length of the animal, dorsally rounded posteriorly, anteriorly carinated over the frontal region and produced to a rostrum that is rather more than half the length of the carapace, and armed on the upper margin with fifteen or sixteen teeth, and on the under with four or five. The outer canthus of the orbit is rounded, the antennal tooth is well defined, and behind it, almost in a horizontal line, stands the hepatic tooth.

The pleon is smooth; the third somite is scarcely longer than the fourth, and the sixth is not longer than the fifth and shorter than the fourth.

The telson is laterally compressed and tapering; the dorso-lateral angle is furnished on either side with two solitary minute spines and a fasciculus of hairs on the mediodorsal surface near the base, the apex is centrally pointed and armed on either side with a long and a short spine, and on the under surface of the margin with a fringe of hairs.

The ophthalmopoda are pyriform, and carry an ocellus within a curve in the margin of the ophthalmus.

The first pair of antennæ has the peduncle one-third shorter than the rostrum; the first joint is equal in length to the second and third together, is excavate on the upper surface, and armed on the outer margin with a short stylocerite and a strong tooth at the distal angle; the two following joints are cylindrical, subequal, and support two flagella, the inner of which is slender and half the length of the animal, the outer is stouter at the base and divides into two branches, of which the inner is half the length of the outer, which equals the entire animal in length.

The second pair of antennæ carries a scaphocerite of the generic form that reaches to the extremity of the rostrum, and a flagellum that is twice the length of the animal.

The second pair of gnathopoda terminates in a sharp unguis and reaches as far as the distal extremity of the peduncle of the first pair of antennæ.

The first pair of pereiopoda is slender and cylindrical, the propodos being not broader than the distal extremity of the carpos, which is as long as the ischium and meros together; the basis is cylindrical, the inner margin not being developed into a plate as in *Bithynis lar*. The second pair has the two limbs unequal. The right is the larger and different in form; it is as long as the animal, and has the meros, carpos, palm of the propodos and dactylos subequal in length, the propodos being subcylindrical near the base and flattened towards the fingers; the pollex is serrate in the central axis as well as on the inner and outer margin, and armed with a broad, conical cusp about one-third its length from the articulation; the dactylos resembles the pollex, against which it impinges from the apex to the cusp, where there is a corresponding excavation to receive each. The cusp on the dactylos is smaller and more advanced in position than that on the pollex. The left limb is about two-thirds the length of the right, has the fingers of the chela longer than the palm, the margins parallel and closely impinging throughout their entire length, unarmed, and fringed with long hairs. The three following pairs of pereiopoda terminate in an unguis that is sharp and suddenly narrows from the dactylos; the propodos is long, cylindrical, and armed with a few short spines on the posterior margin.

The outer plates of the rhipidura are longer than the telson.

Female.—Resembles the male in general form but differs in size, and in the relative importance of the second pair of pereiopoda. These are equal in length on the two sides and resemble the smaller limb in the male, excepting that they are not hirsute, the tubercular cusps in the right being reduced to a minimum; they are about three-fourths the length of the animal.

Several specimens were laden with numerous, small, oval eggs, some of which appear to be approaching maturity.

	Male.	Female.
Length, entire, ...	64 mm. (2·5 in.)	48 mm. (1·9 in.)
„ of carapace, . . .	22 „	15 „
„ of rostrum, . . .	15 „	12 „
„ of pleon, . . .	42 „	33 „
„ of third somite of pleon, .	10 „	7 „
„ of sixth somite of pleon, .	6 „	5 „
„ telson, ...	10 „	8 „

Habitat.—Honolulu. About fifty specimens were bought in the market, having been obtained from the fresh-water rivers on the island.

Four specimens were also procured from the same locality, associated with the others, and having a close specific resemblance in all parts, excepting the left arm of the second pair of pereiopoda, the hand of which, instead of being small with the fingers parallel and impinging, has them twice the length of the palm, curved and gaping from base to apex, and thickly covered with long hairs. In every case the right arm is broken off, and I could not discover among the detached arms any that appeared to belong to this variety. The length of the arm is proportionate to the animal and is also much longer than in the typical specimen.

The large chelate pereiopoda in this specimen has the right and left very unequal, the left being more slender and shorter than the right.

In some specimens the left hand, which is generally the smaller, has the fingers gaping and only meeting at the apex, while in others, which Dana considers to be the younger, the fingers meet in their entire length. In both they are somewhat hirsute but more especially in those in which the fingers are convex.

Brachycarpus, n. gen.

Resembles *Palæmon*. The outer canthus of the orbit is defined, the first antennal tooth being distinct from it; there is no second antennal tooth, but there is one on the hepatic region, which instead of being in the same horizontal line with the first antennal tooth, as in *Palæmonella* and *Bithynis*, is situated obliquely below and posterior to it.

The second pair of gnathopoda is unguiculate.

The first pair of pereiopoda has the carpos long and cylindrical, and the propodos short. The second pair has the carpos shorter than the meros and triangulate, and the propodos long and cylindrical.

The branchial arrangement is the same as in *Palæmon*.

Geographical Distribution.—Specimens of this genus have been found in the North Atlantic and South Pacific.

Brachycarpus savignyi, n. sp. (Pl. CXXIX. fig. 4).

Rostrum horizontal, dorsally crested with seven strong teeth, of which three are posterior to the orbital margin, and four anterior to it, and having three on the lower margin; one large tooth is situated outside the orbital angle, and one of less importance on the hepatic region. The rest of the carapace is smooth, as are also all the somites of the pleon.

The ophthalmopoda are short and the ophthalmus hemispherical.

The first pair of antennæ has a short stylocerite.

The second pair of pereiopoda is long and stout, and the inner margin of the pollex and dactylos is thickly fringed with stout hairs.

The telson is shorter than the branches of the rhipidura, dorsally flanked on each side within the margins by two distant small spines, and a long and a short one on the margin on each side of the terminal extremity.

Length, entire,	50 mm. (2 in.).
„ of carapace,	14 „
„ of rostrum,	9 „
„ of pleon,	36 „
„ of third somite of pleon,	9 „
„ of sixth somite of pleon,	4 „
„ of telson,	7 „

Habitat.—Bermuda, shallow water.

The carapace is nearly one-third the length of the animal; the frontal region is crested and anteriorly produced to a rostrum that is about two-thirds the length of the carapace, and armed on the upper margin with seven large teeth, of which the most anterior is the smallest and stands near the apex, and the posterior is situated above the pyloric region. The frontal margin has the orbital notch traversed by a lunate lacuna, and the canthus is situated inside of the first antennal tooth, which in this species is well defined by a slight projection; behind and a little beneath stands the hepatic tooth, which is the only other tooth on the frontal surface of the carapace, the fronto-lateral margin sloping away from the lower portion of the second pair of antennæ.

The pleon is dorsally rounded and laterally compressed, the third somite is longer than the second and longitudinally arcuate; the sixth somite is but slightly longer than the fifth, which is shorter than the fourth.

The ophthalmopoda are short and stout and the ophthalmus is large, ovate, laterally compressed, and furnished with an ocellus within its posterior margin.

The first pair of antennæ has the first joint of the peduncle nearly twice as long as the second and third together, excavate on the upper surface, laterally extended, and of great tenuity; it is armed near the base with a short flat stylocerite that reaches to less than half the length of the joint, and furnished at the outer distal angle with a strong, flat, sharp tooth. The second and third joints are short, cylindrical, and terminally support two flagella, the inner of which is very slender, and the outer stout at the base, and continuing a distance nearly equal to the length of the peduncle before sending off the secondary ramus. Beyond the point of bifurcation, the two rami are slender and thread-like; length undetermined.

The second pair of antennæ supports a strong scaphocerite that reaches beyond the extremity of the rostrum, and carries a long and slender flagellum that is about half the length of the animal.

The mandibles are like those of *Palæmon*, and appear not to differ specifically from those of *Palæmon serratus;* the psalistoma is broader at the base than at the extremity, the molar process is angular and well developed, and the synaphipod is very slender, three-jointed, and not longer than the psalistoma.

The oral appendages closely resemble those of *Palæmon*, exhibiting no conspicuous variation.

The gnathopoda also correspond with those of *Palæmon serratus*, excepting that the second pair has the extremity terminating in a long and sharp-pointed unguis, and the appendage is more thickly fringed with hairs in numerous fasciculi.

The first pair of pereiopoda is long, slender, and chelate, and formed on the same type as that of *Palæmon serratus;* the coxa is produced on the inner side and supports a brush of hairs; the basis and ischium are both short, the latter being narrower at the basisal articulation than at the meral; the meros and carpos are long and subequal; the propodos is shorter than the carpos, the palm being subequal with the dactylos; the dactylos and pollex are parallel, impinging throughout their entire length, and having their extremities rounded on the outer margins. This pair of appendages corresponds with that of the typical *Palæmon*. The second pair of pereiopoda is very long and very large; it has the carpos short, the propodos long and cylindrical, the palm about twice the length of the pollex, and the pollex slightly curved and furnished on the inner margin with two strong, obtusely pointed teeth or tubercles; the dactylos is also curved, and a trifle longer than the pollex, and each of these joints terminates in a sharp, strong, opposing unguis, and has the inner margin broad and fringed with a closely packed row of strong but short hairs, so that when the chela is closed the intervening space is filled with a brush of hairs. The three posterior pairs of pereiopoda are robust and not very long; the meros is longer than the ischium, and the carpos is one-third shorter than the meros and overlaps the propodal articulation on the anterior surface; the propodos is a third longer than the carpos, and furnished with two or three solitary spinules on the posterior margin; the dactylos is short, curved, and terminates in a curved, bifid unguis, both points being sharp.

The pleopoda are foliaceous, biramose, and have the basal joint broad and flat.

The rhipidura has the outer plate furnished with a short tooth, and a longer spine at the outer extremity of the diæresis, the inner plate is subequal with the outer, and both longer than the telson.

The telson is broad at the base, narrow and pointed at the extremity, and has the dorsal surface flattened; the dorso-lateral angle on each side is armed with two solitary, short, stout spines, one behind the other, and the posterior angle on each side with a short spine, immediately to the inner side of which is a second spine about one-eighth the length of the telson; between these spines on the under surface the margin is fringed with hairs subequal with the larger spines.

Observation.—This species bears a very close relationship to *Palæmon beaupressii* of Savigny and Audouin, as well as to *Palæmon petitthouarsii* of the same authors.

Brachycarpus audouini, n. sp. (Pl. CXXIX. fig. 5).

Animal robust, carapace produced anteriorly to a lanceolate rostrum, upper and lower margins serrate with many teeth, of which the posterior on the dorsal surface is separate from the rest and corresponds with the pyloric region; the orbit is clearly defined, and the first antennal tooth is sharp and distinct, as is also that on the hepatic region.

The three first somites of the pleon are deeper than the carapace, the four succeeding are shorter, less deep, and more compressed; the sixth somite is only a little longer than the fifth, and projects to a tooth, flanking the telson on each side.

The telson is long, tapering, and armed with three spinules on each side.

The second pair of antennæ is longer than the animal.

The first pair of pereiopoda is slender, small, and differing a little on the two sides. The second pair has only the left limb preserved; it is about two-thirds the length of the animal, and has the propodos, including the chela, five times as long as the carpos. The posterior pereiopod on the right side is the only one of the posterior three pairs that is preserved; it is slender, moderately long, and terminates in a long, sharp, unadorned dactylos.

Length, entire (female),	16 mm. (0·6 in.).
„ of carapace,	5 „
„ of rostrum,	3 „
„ of pleon,	11 „
„ of third somite of pleon,	3 „
„ of sixth somite of pleon,	2 „
„ of telson,	3 „

Habitat.—Station 167A, June 27, 1874; lat. 41° 4′ S., long. 174° 19′ E.; off New Zealand; depth, 10 fathoms; bottom, mud. One specimen, female, laden with small ova. Dredged.

The carapace is about one-third the length of the animal, anteriorly produced to a laterally compressed rostrum, the upper margin of which is in a line with the dorsal surface of the carapace and a little more than half its length; it is armed with nine teeth, of which the posterior corresponds with the post-gastric region and is more distant from the next than the preceding are from each other, the latter becoming gradually closer and smaller as they approach the apex, the anterior being very minute; on the under margin there are six teeth, of which the posterior is the largest and the anterior the smallest, corresponding in size and position with those on the upper margin.

The frontal margin is armed with an obtuse orbital, and a sharp antennal, tooth,

and behind and below this a hepatic tooth; the frontal and lateral margins of the carapace meeting at a slightly obtuse angle, which, however, is not produced to a tooth.

The pleon is dorsally rounded and laterally compressed, has the third somite longer than the others and dorsally arcuate; the sixth somite is nearly twice as long as the preceding.

The ophthalmopoda are short and pyriform, and the ophthalmus is round, with a distinct ocellus on the margin.

The first pair of antennæ has the first joint of the peduncle longer than the two succeeding joints, and is furnished with a stylocerite that is half the length of the joint, which is armed on the outer distal angle with a sharp tooth. The second and third joints are cylindrical and support two flagella, the inner of which is long and slender, and the outer stout at the base and soon dividing into two branches, of which the shorter is the chief and the more robust, and carries a series of membranous cilia; the secondary branch is as slender as the inner flagellum, and subequal to it, both being as long as the carapace.

The second pair of antennæ is longer than the animal and supports a scaphocerite that reaches beyond the extremity of the rostrum, and is armed on the outer margin with a tooth that is behind the level of the anterior margin.

The second pair of gnathopoda is short, slender, and pediform; it carries a basecphysis that reaches nearly to the penultimate articulation, and has the terminal joint fringed and tipped with long, serrate hairs or spinules.

The first pair of pereiopoda when extended reaches as far as the apex of the rostrum, and is slender and chelate; the carpos is as long as the meros and longer than the propodos, inclusive of the pollex. The fingers are as long as the palm and impinge closely together in their whole extent. The second pair is nearly twice as long as the first; the propodal articulation of the carpos, and the extremity of the dactylos, reach as far again; the meros is long and narrow, with the margins parallel; the carpos is narrow at the meral extremity and wide at the propodal; the propodos is subcylindrical, forms about half the length of the appendage, and is not much broader than the distal extremity of the carpos; the pollex is scarcely half the length of the palm, and the dactylos is more curved than the pollex; they meet together in their entire length. The three succeeding pairs, so far as may be judged from the solitary member of the posterior pair, are slender and not very long, the upper angle of the carpal extremity overlapping the propodal articulation; the propodos is long, straight, and cylindrical, and the dactylos is long, slender, curved, and uniunguiculate.

The pleopoda are biramose, long, narrow, and foliaceous. The rhipidura has the lateral plates longer than the telson, and the outer extremity of the diæresis is armed with a tooth and a spine.

The telson is dorsally smooth, laterally compressed, and has the dorso-lateral angle

armed with two short solitary spinules, placed longitudinally on each side, and terminating in two long lateral and one central spine.

Observations.—This species bears a close relationship to *Brachycarpus savignyi*, which was taken at Bermuda, also in comparatively shallow water. It differs, however, in several points of specific value, notably in the form of the dactylos of the posterior pereiopoda, which in this species is single-pointed, while in *Brachycarpus savignyi* it is bifid. The fingers of the large chela in *Brachycarpus savignyi* are broad and gaping, the gap containing tubercles and a mass of hairs, while in *Brachycarpus audouini* the fingers impinge in their entire length, and are devoid of hairs or tubercles.

Nematocarcinus, A. Milne-Edwards.

Nematocarcinus, A. Milne-Edwards, Ann. d. Sci. Nat., sér. 6, tom. ix. p. 14, 1884.

Dorsal surface of the carapace and pleon continuously smooth and even. Carapace anteriorly produced to a laterally compressed rostrum that is finely and more or less abundantly serrate on the upper surface and smooth on the lower, or at most armed with very small teeth. Frontal margin furnished with one tooth, corresponding with the outer angle of the first pair of antennæ, and a second at the fronto-lateral angle, from whence the inferior margin immediately recedes.

The ophthalmopoda are short, and the ophthalmus globular.

The first pair of antennæ has the first joint deeply excavate, and furnished with a stylocerite; the second and third joints are short and robust, terminating in two extremely long and slender flagella, the outer of which is stout near the base.

The second pair of antennæ carries a long scaphocerite, and terminates in an extremely long and slender flagellum.

The mandibles have the psalistoma and molar processes distinct, and carry a two-jointed synaphipod.

The first pair of gnathopoda has the terminal joints reflexed, and carries a long basecphysis and a well-formed mastigobranchial plate.

The second pair of gnathopoda terminates in a long spatuliform joint, and is furnished with a long basecphysis.

The first two pairs of pereiopoda are slender and perfectly chelate, the second being much longer than the first, and having the carpos about four times the length of the propodos. The three following pairs are extremely long, and are remarkable for the peculiar overlapping articulation between the ischium and meros, in having the carpos many times longer than the propodos, and terminating in a short and sharp dactylos.

The telson is subequal with the inner branch of the rhipidura.

This genus is remarkable for the great length of the antennæ, more especially those of the first pair, which are frequently three or four times the length of the animal; and the

great length of the pereiopoda, more especially the three posterior pairs, which is chiefly caused by the enormous length of the ischium, meros, and carpos. The articulation between the ischium and meros is, moreover, of peculiar and unique character, and seems probably adapted for the great muscular strain consequent upon the length of the joints. The extremity of the ischium lies longitudinally under the meros, so that these joints overlap and support each other. The propodos, coxa, and basis are very short, and the last supports a short two-jointed ecphysis.

The ventral surface of the pereion in the male carries on each of the three posterior somites a flat anteriorly projecting plate or process on each side of the median line, and the female carries a similar process on the fourth somite, but not on either the fifth or sixth.

The branchial arrangement consists of a series of pleurobranchiæ and rudimentary mastigobranchiæ, as may be seen from the following table :—

Pleurobranchiæ, . . .	...	...	1	1	1	1	1
Arthrobranchiæ, . . .	...	1	1	1	1	1	...
Podobranchiæ, . . .	1	...	...	...	...	...	...
Mastigobranchiæ, . . .	1	1	r	r	r	r	...
	h	i	k	l	m	n	o

Geographical Distribution.—Several species of this genus have been found in different parts of the globe. It was first taken by the Challenger in the Southern Indian Ocean at the depth of 1200 fathoms, and again near the Kermadec Islands and the Fiji Islands at 600 fathoms; in the narrows between Borneo and Celebes, specimens are recorded from 255 fathoms. Off Yedo in Japan others were taken at depths of 350, 560, and 1875 fathoms. Specimens have also been recorded from the Gulf of Mexico and the Mediterranean by A. Milne-Edwards. In all instances excepting one the bottom was either mud or ooze; in the exceptional case it was rocky. The bottom temperature varied from 35°·3 to 41°·8.

I am inclined to believe that the animals live at an average depth of between 300 and 500 fathoms in mid-water.

Nematocarcinus undulatipes, n. sp. (Pl. CXXX.).

Rostrum horizontally straight, one-third the length of the carapace, armed on the upper margin with twelve or thirteen small teeth, and on the lower margin with one small tooth near the apex; beyond this tooth the margin suddenly curves towards the extremity.

Ophthalmopoda short and orbicular.

First pair of antennæ having the peduncle short and stout, and the flagella subequally slender, extending to about three times the length of the animal.

Second pair of antennæ having a scaphocerite as long again as the rostrum, and carrying a flagellum that is subequal with those of the first pair.

Second pair of gnathopoda terminating in a long spatuliform joint fringed with short hairs.

First pair of pereiopoda slender, chelate, and as long again as the second pair of gnathopoda. Second pair slightly more robust than the first, and about twice its length. Posterior three pairs much longer and increasing in length posteriorly, the meros being armed with a strong tooth at the carpal extremity, where it is slightly enlarged to receive the carpos, which is considerably longer than any of the other joints of the leg; the dactylos is long and waved in the third and fourth pairs, and stunted and rudimentary in the fifth, where it is lost in a brush of long hairs.

The third somite of the pleon is dorsally arcuate, and the telson long, narrow, and tapering.

	Female.	Male.
Length, entire, . . .	78 mm. (3 in.).	58 mm. (2·2 in.).
„ of carapace, . .	23 „	18 „
„ of rostrum, . .	7 „	4 „
„ of pleon, . . .	55 „	40 „
„ of third somite of pleon, .	10 „	9 „
„ of sixth somite of pleon, .	13 „	10 „
„ of telson, . . .	11 „	12 „
„ third pair of pereiopoda, .	105 „	54 „
„ fifth pair of pereiopoda, .	...	100 „
„ first antenna, . .	300 „	150 „

Habitat.—Station 200, October 23, 1874; lat. 6° 47′ N., long. 122° 28′ E.; off Sibago, Philippine Islands; depth, 250 fathoms; bottom, green mud. Fifteen specimens; five males, ten females. Trawled.

Station 171, July 15, 1874; lat. 28° 33′ S., long. 177° 50′ W.; north of the Kermadec Islands; depth, 600 fathoms; bottom, hard ground; bottom temperature, 39°·5. Three specimens, males. Trawled.

Length, male, 113 mm. (4·4 in.).

Station 194, September 29, 1874; lat. 4° 34′ S., long. 129° 57′ 30″ E.; off Banda Island; depth, 200 fathoms; bottom, volcanic mud. One specimen, female. Dredge and trawl both used.

Station 214, February 10, 1875; lat. 4° 33′ N., long. 127° 6′ E.; south of the Philippine Islands; depth, 500 fathoms; bottom, blue mud; bottom temperature, 41°·8. Three specimens, one female. Trawled.

The rostrum is short and horizontal, about one-third of the length of the carapace, and is serrate with numerous small teeth above and with one minute tooth below near the apex, but which is omitted in the figure on the plate. The anterior margin is furnished

with a first antennal tooth, situated near the outer canthus of the orbit, and a second corresponding with the antero-lateral angle of the carapace, from which the anterior margin directly recedes posteriorly in a horizontal line.

The pleon has the dorsal surface smooth, with a small gibbous prominence near the posterior margin of the third somite.

The ophthalmopoda are short and orbicular, scarcely reaching beyond the antennal tooth.

The first pair of antennæ has the peduncle tolerably robust; the first joint is deeply excavate to receive the eye, and carries a stiff sharp stylocerite, and the second and third joints are short and cylindrical. From the extremity of the third joint, which extends but little beyond the apex of the rostrum, arise two flagella, the outer and upper of which is stout at the base, multiarticulate, and from three to four times the length of the animal; the inner flagellum is slender, cylindrical, and equals the outer in length.

The second pair of antennæ has a short peduncle, and supports a scaphocerite that is rounded at the extremity and strengthened at the outer margin by a longitudinal ridge which terminates in a sharp tooth near the distal extremity. The flagellum is very long and slender, being subequal with those of the first pair.

The mandible is strong and has the psalistoma dentate and separate from the molar process, and it carries a two-jointed synaphipod, of which the distal joint is ovate and fringed with hairs.

The siagnopoda exhibit nothing of specific value.

The first pair of gnathopoda is six-jointed; the terminal joint is long-ovate; the basis carries a long slender ecphysis, and the coxa supports a membranous mastigobranchial plate, to which is attached a short podobranchial plume.

The second pair of gnathopoda is long and pediform, and terminates in an ovate spatuliform joint; the basis carries a slender ecphysis, and the coxa the rudiment of a mastigobranchial plate without any modification of a podobranchial plume.

The first pair of pereiopoda is chelate, the chela being small; the propodos is slender and short; the dactylos is minute; the carpos is long, slender, cylindrical, and smooth; the meros and ischium are long, slender, and united by a peculiar, long, overlapping joint, and armed on the lower margin with a series of long spine-like teeth. The second pair, which is about twice the length of the first, is chelate, the chela having the dactylos cylindrical and the pollex concave; the propodos is long and subcylindrical, but short compared with the carpos, which is about four times as long and half the diameter; the meros and ischium are together about equal in length to the carpos, and are united by a long overlapping joint and armed on the lower margin with a few teeth. The three following pairs of pereiopoda are about as long again as the second; the third and fourth terminate in a comparatively long and waved dactylos, while that of the fifth pair is short and rudimentary. The propodos is short, broader at the distal than at the carpal extremity, and carries a brush of hairs at the distal extremity, amongst which in the

posterior pair the dactylos is embedded; the carpos is long, slender, and cylindrical, being about fourteen times longer than the propodos, and nearly as long as the meros and ischium united; these two joints are united by a long overlapping articulation, and are both fringed with spine-like teeth, and the meros is armed with a strong tooth at the anterior distal angle that projects above the carpal articulation.

The telson equals in length the inner branch of the rhipidura, and is smooth and unarmed.

Observations.—This species appears to be the most common form; the females carry a considerable number of small round ova. The specimens taken at Station 200 were numerous, and were associated with several other genera, such as *Pontophilus*, *Heterocarpus*, *Solenocera*, *Palæmonella*, &c. Three of the specimens here taken were attacked by a species of *Bopyrus*.

The three specimens taken at Station 171 differ in size and in some minor points from the others, but belong I believe to this species. They are all males and are larger than the largest female taken elsewhere, measuring 113 mm. The carapace is 31 mm., and the rostrum 9 mm. long. They are also furnished with twelve or thirteen points on the frontal crest and upper margin of the rostrum, and with one small one near the apex on the lower margin, which appears to be a feature more common in the males than females, although seen in some of these also, and when not present the rostrum is thicker towards the apex, which is perhaps its normal condition.

The female specimen taken at Station 194 has the subapical tooth on the under margin of the rostrum developed into a strong and well-formed denticle, and much more conspicuous than in any of the numerous specimens which are typical in form from other localities.

This species differs from *Nematocarcinus gracilis* chiefly in having a less number of teeth on the upper surface of the rostrum.

Nematocarcinus lanceopes, n. sp. (Pl. CXXXI.).

Rostrum projecting anteriorly, nearly as long as the carapace, armed on the upper surface with a series of very small teeth, about twenty-six in number, and on the lower with eight teeth and no fringe of cilia.

Ophthalmopoda short and embayed in a deep orbital notch, which is armed at the outer angle with a sharp antennal tooth.

First pair of antennæ having the peduncle about half the length of the rostrum; first joint excavate to receive the ophthalmopoda and the other two short and cylindrical; the flagella are long and slender, the outer being a little larger at the base than the inner.

Second pair of antennæ carrying a scaphocerite that is nearly as long as the rostrum, and a long and slender flagellum.

Second pair of gnathopoda terminating in a long spatuliform joint.

First two pairs of pereiopoda chelate, the propodos being rather less than half the length of the carpos, which corresponds in length with the meros and ischium combined. Two succeeding pairs of pereiopoda missing. Posterior pair long, and terminating in a short, broad, and lanceolate dactylos, which articulates with the propodos in the centre of a cup-shaped hollow fringed with long hairs; the propodos is short and cylindrical, but four times as long as the dactylos; the carpos is long and cylindrical, being about twelve times as long as the propodos and a little longer than the meros, which is not armed with a prominent tooth at the carpal extremity, but is sparsely fringed with spine-like teeth on the posterior margin, and is connected with the ischium by an overlapping articulation. All the pereiopoda, excepting the last pair, carry a basecphysis, and also a rudimentary mastigobranchial plate.

Telson subequal with the outer plate of the rhipidura, dorsally flat, smooth, and fringed with a few hairs at the extremity, and short spinules on the latero-dorsal angle.

	Female.	Male.
Length, entire, . . .	106 mm. (4·1 in.).	90 mm. (3·5 in.).
„ of carapace, . . .	31 „	25 „
„ of rostrum, . . .	25 „	24 „
„ of pleon, . . .	75 „	65 „
„ of third somite of pleon, .	12 „	12 „
„ of sixth somite of pleon, .	19 „	16 „
„ of telson, . . .	21 „	18 „

Habitat.—Station 152, February 11, 1874; lat. 60° 52′ S., long. 80° 20′ E.; Antarctic Sea; depth, 1260 fathoms; bottom, Diatom ooze. Three specimens; one male, two females. Associated with *Pentacheles.* Trawled.

This species was originally named from a belief that the posterior three pairs of legs terminated in a dactylos that was short and lanceolate in form, but the specimens are damaged, and although in my original notes I have recorded the three pairs as being so shaped, my drawing represents only two. I think that there is a possible error in the description, inasmuch as I had not at the time observed that the posterior pair in many and probably all species is rudimentary, so as to make it a distinction of generic value. The dactylos in this pair is short, broad, and lost among a mass of stiff hairs that fringe the distal margin of the propodos; it is lanceolate in form, but whether the preceding two are so or not I cannot determine.

The females were laden with ova of an oval form, and much larger than those of other species in which eggs have been observed. The pereiopoda that are preserved attached are not quite so long proportionately as in some other species, a circumstance that is due to the carpos being not quite so long in relation to the meros to which it is attached.

The third somite of the pleon is slightly arcuate at the posterior portion, and the telson is slightly longer than in some species. Most of the other features are only of generic value and unimportant in the determination of species.

Nematocarcinus longirostris, n. sp. (Pl. CXXXII. fig. 2).

Rostrum slender, elevated anteriorly, and produced to a length that surpasses that of the carapace; armed on the upper surface with a large number of minute teeth and spinules, from thirty-eight to forty in number, of which those at the posterior extremity are very minute and closely-packed articulating spinules, and those towards the anterior extremity are fewer in number and more widely separated, and as they increase in size they lose their articulated condition and become tooth-like in character. The under surface is armed with five small rigid teeth.

Telson subequal in length with the lateral plates of the rhipidura.

Most of the specimens have the appendages broken off so that it is difficult to determine the characters further.

	Male.	Female.
Length, entire, . . .	87 mm. (3·4 in.).	124 mm. (4·9 in.).
„ of carapace, . .	25 „	35 „
„ of rostrum, . . .	26 „	48 „
„ of pleon, . . .	62 „	89 „
„ of third somite of pleon, .	13 „	15 „
„ of sixth somite of pleon, .	15 „	20 „
„ of telson, . . .	17 „	20 „

Habitat.—Station 237, June 17, 1875; lat. 34° 37′ N., long. 140° 32′ E.; near Yokohama, Japan; depth, 1875 fathoms; bottom, blue mud; bottom temperature, 35°·3. Ten specimens; three males, seven females, one bearing ova. Associated with *Nematocarcinus proximatus* and *Nematocarcinus parvidentatus*. Trawled.

This species corresponds very closely with *Nematocarcinus lanceopes*, so far as can be determined. Unfortunately, however, the pereiopoda are more or less broken off in all the specimens, and the definition of the species must be chiefly founded on the relative proportions of the body given in the above table.

The rostrum, which has the apex broken off, is about one-third of the length of the animal, and is the chief distinguishing feature of this species. It is proportionally longer and more slender than in *Nematocarcinus lanceopes*, and carries a greater number of teeth and spinules on the upper margin and fewer on the lower.

The branchial region is defined from the cardiac and hepatic regions by a longitudinal elevation external to a furrow, and from the antennal region by a similar furrow.

The ophthalmopoda are large and pyriform, having the ophthalmus hemispherical.

The first pair of antennæ has the peduncle about one-fourth the length of the rostrum, and carries at its base a stylocerite that is at first broad and then suddenly sharp pointed, and about half the length of the first joint; the succeeding two joints are short and subcylindrical, and terminate in two flagella that are broken off short.

The second pair of antennæ carries a scaphocerite that reaches to about half the length of the rostrum; it is waved on the outer margin, which is stout and rigid, and terminates in a small latero-apical tooth; it is separated from a median ridge by a longitudinal furrow, and the inner margin is also strengthened by a ridge that becomes stronger as it approaches the base, and is fringed with long and sparsely ciliated hairs.

The first pair of gnathopoda is generic in character.

The second pair is also chiefly generic; the terminal joint does not reach quite to the distal extremity of the scaphocerite, and is long, narrow, lanceolate, and hirsute; the penultimate is rather longer, cylindrical, and smooth; the antepenultimate suddenly increases in diameter, gradually widens and flattens towards the base, and probably represents the ischium and meros united; the basis is short and carries an ecphysis that is three-fourths the length of the antepenultimate joint; the coxa is short and supports a thick disc-like plate projecting from the outer side of the posterior surface, from which a rigid mastigobranchial rod also projects.

All the pereiopoda except the posterior pair carry a moderately long ecphysis, and a short, ovate, mastigobranchial plate.

The third somite of the pleon projects dorsally to a point that lies close against the surface of the fourth somite, and the sixth, which is longer than the two preceding, is laterally compressed.

The telson is subequal with the outer branch of the rhipidura, and armed on each side, on the dorso-lateral angle, with seven small spinules.

All the specimens are more or less damaged, but one female was heavily laden with ova, which are small and round, therefore clearly demonstrating the species to be specifically distinct from *Nematocarcinus lanceopes*, which was taken in the Indian Ocean.

Other specimens that I have placed under separate specific names were taken associated with *Nematocarcinus longirostris*, and bear to it a considerable resemblance in all points excepting the relative length of the rostrum, and the consequent amount of ornamentation on it. This is more apparent in those that depart slightly from the exact form of the type specimen.

There were nine or ten specimens taken, all of them well grown, though none quite so large as the one selected for description. Each of these varies in some degree, especially in the length of the rostrum as compared with that of the carapace, and in some instances in the number of the teeth also, but in all these instances the teeth on the lower margin have the posterior subequal with or in advance of the distal extremity of the peduncle of the first pair of antennæ.

Nematocarcinus proximatus, n. sp. (Pl. CXXXII. fig. 3).

Rostrum as long as the carapace, armed on the upper surface with thirty-three or thirty-four small teeth and spinules, and one on the lower margin.

Telson about as long as the outer plates of the rhipidura.

Length, entire,	106 mm. (4·1 in.).
„ of carapace,	30 „
„ of rostrum,	31 „
„ of pleon,	76 „
„ of third somite of pleon,	15 „
„ of sixth somite of pleon,	18 „
„ of telson,	20 „

Habitat.—Station 300, December 17, 1875; lat. 33° 42′ S., long. 78° 18′ W.; west of Valparaiso; depth, 1375 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·5. Three specimens, females. Associated with *Willemoesia*. Trawled.

Station 146, December 29, 1873; lat. 46° 46′ S., long. 45° 31′ E.; near Marion Island; depth, 1375 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·6. Two specimens, females; 63 mm. and 100 mm. long. Trawled.

Station 188, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; Arafura Sea; depth, 28 fathoms; bottom, green mud. Fifteen specimens; eight males, seven females. Trawl and dredge both used.

Station 237, June 17, 1875; lat. 34° 37′ N., long. 140° 32′ E.; near Yokohama, Japan; depth, 1875 fathoms; bottom, blue mud; bottom temperature, 35°·3. One specimen, female. Trawled.

Station 302, December 28, 1875; lat. 42° 43′ S., long. 82° 11′ W.; off the west coast of America; depth, 1450 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·6. Three specimens; one male, one female, bearing ova; one doubtful, probably a young male. Trawled.

This species differs from *Nematocarcinus longirostris* only in the length of the rostrum and in the variation in the number of teeth upon it, more especially on the lower margin, which in the typical specimen of this species bears only one, and that somewhat distant from the extremity of the rostrum, while in *Nematocarcinus longirostris* there are five, and the distal one approaches near the apex of the rostrum. In a young male specimen from Station 188, and in a female, bearing ova, from Station 302, there are two teeth on the lower margin, thus showing a tendency to vary in this character, and although for the sake of the convenience of classification I call them by different specific names, I cannot help feeling that they are mere variable forms of one deep-sea species. Unfortunately, every specimen of both *Nematocarcinus longirostris* and *Nematocarcinus proximatus* is more or less mutilated, and the posterior pereiopoda, from

their long and slender character, are particularly liable to be broken. The consequence is that there is only one specimen, a male, out of the three taken at Station 300, in which any of the pereiopoda are preserved; this specimen is smaller than the one from which the measurements are taken.

The rostrum in the smaller specimen is only two-thirds the length of the carapace, and is 20 mm. long, while the carapace measures 28 mm. The ophthalmus is more globular than in *Nematocarcinus longirostris*. The peduncle of the first pair of antennæ is about half the length of the rostrum, and the scaphocerite reaches to a point but little short of the apex of the rostrum, while in the larger specimen it falls short by about one-third of its length. The first pair of pereiopoda has the chela long and the dactylos slender and as long as the palm. The second pair of pereiopoda has the chela short and the dactylos half the length of the palm, and reaching a little beyond the extremity of the scaphocerite, while that of the first pair falls short of the same. The only other pereiopod that has been preserved is the right penultimate, in which the carpos is seen to be a little longer than the meros and more slender; the propodos is also slender and comparatively long, and the dactylos is long, slender, and curved, and is also embedded in a fasciculus of straight and long hairs.

The rest of the animal differs little from other allied species.

Nematocarcinus altus, n. sp. (Pl. CXXXII. fig. 4).

Rostrum long and slender, nearly of the same length as the carapace, armed on the upper surface with ten small spinules close together on the frontal crest, posterior to the orbits, and with five or more teeth on the rostrum proper, and on the under surface with two or more small ones.

Telson shorter than the outer branch of the rhipidura.

Length, entire,	115 mm. (4·5 in.).
„ of carapace,	35 „
„ of rostrum,	31 „
„ of pleon,	80 „
„ of third somite of pleon,	15 „
„ of sixth somite of pleon,	22 „
„ of telson,	20 „

Habitat.—Station 198, October 20, 1874; lat. 2° 55′ N., long. 124° 53′ E.; south of the Philippine Islands; depth, 2150 fathoms; bottom, blue mud; bottom temperature, 38°·9. One specimen, male. Trawled.

Only one specimen of this species was procured, from which all the appendages are wanting, and the rostrum is broken near the apex. The number of teeth is not nearly so great as on the rostrum of *Nematocarcinus longirostris* or even of *Nematocarcinus*

proximatus. The chief distinctive feature, however, exists in the very decided difference, both in position and character, of the armature on the frontal crest posterior to the orbits, and which consists of ten small movable spinules closely planted together, from that on the rostrum anterior to the orbits, which consist of eight low-lying fixed teeth, that are placed widely apart. The portion of the rostrum which was broken off has been found, so that its length can be accurately determined to be over two-thirds the length of the carapace, or a little longer than the scaphocerite, and it gradually narrows from the base to the extremity. On the under side of the rostrum there are not any very conspicuous teeth, but five small points can be determined by close observation amidst a fringe of hairs.

The branchial region is defined by fossæ from the cardiac and hepatic regions, and the latter from the gastric and frontal.

The third somite of the pleon is dorsally produced to a point that reaches, when the animal is extended, to about two-thirds the length of the succeeding somite.

Observations.—The specimen is too much damaged to enable me to describe any other important distinctions from closely allied species, such as *Nematocarcinus lanceopes*, *Nematocarcinus proximatus*, and *Nematocarcinus longirostris.*

This species may be at once recognised by the number and position of the frontal teeth, and by the shortness of the telson, which does not quite equal the length of the inner branch of the sixth pleopod, and is considerably shorter than the outer, the apex being on a level with the diæresis.

Nematocarcinus productus, n. sp. (Pl. CXXXII. fig. 5).

Rostrum about half the length of the carapace, anteriorly elevated and gradually tapering; upper or dorsal margin armed with eighteen or nineteen teeth, of which those on the frontal crest are the more closely placed, while those towards the distal extremity of the rostrum are more separated; lower margin smooth and fringed with closely packed cilia.

Third somite of the pleon dorsally arcuate and posteriorly produced so as to cover half the fourth somite, when the pleon is fully extended; posterior three somites obtusely carinated dorsally.

Telson long, narrow, and tapering posteriorly to a truncated apex which is furnished with three or four long stiff hairs or spines.

	Female.	Male.
Length, entire, . . .	91 mm. (3·5 in.).	75 mm. (2·9 in.).
„ of carapace, . .	26 „	22 „
„ of rostrum, . . .	15 „	8 „
„ of pleon, . . .	65 „	53 „
„ of third somite of pleon, .	13 „	10 „
„ of sixth somite of pleon, .	16 „	12 „
„ of telson, . . .	16 „	12 „

Habitat.—Station 205, November 13, 1874; lat. 16° 42′ N., long. 119° 22′ E.; off Luzon, Philippine Islands; depth, 1050 fathoms; bottom, blue mud; bottom temperature, 37°. Six specimens; two males, four females, one laden with ova. Trawled.

Station 195, October 3, 1874; lat. 4° 21′ S., long. 129° 7′ E.; off Banda Island; depth, 1425 fathoms; bottom, blue mud; bottom temperature, 38°. One specimen, female. Trawled.

Station 237, June 17, 1874; lat. 34° 37′ N., long. 140° 32′ E.; near Yokohama, Japan; depth, 1875 fathoms; bottom, blue mud; bottom temperature, 35°·3. One specimen, female. Trawled.

Station 176, August 15, 1874; lat. 18° 30′ S., long. 173° 52′ E.; off the New Hebrides; depth, 1450 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·2.

All the specimens from Station 205 were much damaged, and none of them had any of their appendages preserved, so that I am only able to determine the distinctness of the species by the length, form, and armature of the rostrum, and by the third somite of the pleon being posteriorly produced to an obtuse point over the dorsal surface of the next succeeding somite.

The ophthalmus is less globular than in *Nematocarcinus undulatipes.*

The peduncle of the first pair of antennæ is considerably shorter than the rostrum, and the scaphocerite of the second pair reaches beyond the distal extremity of the rostrum.

Observations.—The ova are ovate in form, very numerous, and in an advanced stage of development. Three of the specimens are undoubtedly of the same species and are females, but two of the others are males and vary in size and other important details. Their lengths are respectively 88 mm. and 75 mm.; they differ also in the depth of the carapace at the genital region, which is 12 mm. and 10 mm. respectively. The length of the rostrum also differs; in one it is 13 mm. and in the other 11 mm., it is more curved upwards in the larger and typical specimen, and the number of teeth on the upper surface is eighteen, the lower margin is free from teeth from the base to the apex, while in the smaller there are twenty-three teeth on the upper surface and a small tooth on the lower near the apex, the rest of the under surface in both forms being fringed with hairs.

It would therefore appear that in the series of teeth on the dorsal crest, a uniform number is certainly not an essential feature of specific distinction, and I am not certain that the solitary tooth on the lower surface in the smaller specimen is a fixed condition, inasmuch as in certain undoubted species, as *Nematocarcinus undulatipes*, there are indications of a tendency to vary in this. But what drew my attention first to the possible distinction of specific condition is the form of the plates on the ventral surface of the males, and that of the inner branch of the first pair of pleopoda. The ventral plates are well developed in each, but the posterior plate in the large form has the lateral processes less developed than in the smaller, and the inner branch of the first pair of

pleopoda, which in the smaller specimen is short, broad, and foliaceous, is in the larger narrow, thick, and lanceolate in form, and about two-thirds the length of the outer branch, assuming much the condition of the same part in the female.

From the imperfect condition of the specimens at my command, I have not been able to make a full comparison, but I am inclined to think that the smaller variety is the more active form of the male animal, whereas the larger variety is one of those older specimens that are becoming effete, and putting on certain appearances which are more generally conspicuous in the females.

A solitary much-damaged female specimen, laden with numerous small ova, was trawled halfway between the Fiji Islands and the New Hebrides at a depth of about a mile and a half from the surface, which I consider as belonging to this same species. Half of the rostrum is broken off, and all the appendages are gone, but the armature of the frontal crest, and the projection to an obtuse point of the posterior dorsal margin of the third somite of the pleon, show its near relationship to the present species.

Nematocarcinus tenuipes, n. sp. (Pl. CXXXII. fig. 6).

Carapace anteriorly produced to a rostrum that is slightly elevated from the base to the apex, and armed on the upper surface with two and twenty small spinules and teeth, and upon the lower surface with one tooth near the extremity.

Pereiopoda long and slender, and terminating in a dactylos that is as long as the propodos.

Telson longer than the inner, and shorter than the outer, plates of the rhipidura.

	Female.	Male.
Length, entire, . . .	92 mm. (3·6 in.).	71 mm. (2·8 in.).
„ of carapace, . . .	26 „	21 „
„ of rostrum, . . .	15 „	8 „
„ of pleon, . . .	66 „	50 „
„ of third somite of pleon, .	11 „	10 „
„ of sixth somite of pleon, .	14 „	12 „
„ of telson, . . .	15 „	12 „

Habitat.—Station 235, June 4, 1875; lat. 34° 7′ N., long. 138° 0′ E.; south of Japan; depth, 565 fathoms; bottom, green mud; bottom temperature, 38°·1. Six specimens; four males, two females. Trawled.

Station 218, March 1, 1875; lat. 2° 33′ S., long. 144° 4′ E.; near the Admiralty Islands; depth, 1070 fathoms; bottom, blue mud; bottom temperature, 36°·4. One specimen (damaged), male. Associated with *Polycheles helleri*. Trawled.

Station 232, May 12, 1875; lat. 35° 11′ N., long. 139° 28′ E.; *Hyalonema*-ground, Japan; depth, 345 fathoms; bottom, green mud; bottom temperature, 41°·1. Six specimens; three males, three females. Trawl and dredge both used.

The specimens taken at Station 235 bear a close resemblance to *Nematocarcinus parvidentatus*, which was obtained at Station 237, about two hundred miles distant. In the females the carapace is armed with ten small spinules on the frontal crest or posterior portion of the rostrum; there being twelve small teeth on the rostrum, that become more distant from each other towards the apex. On the under surface there is one small denticle or point at a short distance from the apex, posterior to which a series of small hairs fringe the margin to the base; the frontal margin is armed with a small antennal tooth and a well-defined one on the antero-lateral angle. The regions on the surface of the carapace are but slightly defined, and the third somite of the pleon is not much produced posteriorly on the dorsal surface.

The ophthalmopoda are short, and the ophthalmus rather small and somewhat reniform.

The first pair of antennæ has the peduncle about two-thirds the length of the rostrum, and the flagella are longer than the animal.

The second pair has a scaphocerite reaching about two millimetres beyond the extremity of the rostrum.

The second pair of gnathopoda reaches as far as the extremity of the rostrum, and has the meros and ischium hirsute.

The pereiopoda are long and slender. The first two pairs are broken off, but a detached portion of the second pair shows the carpos to be very long and slender, and the propodos narrow, with short digits; the meros is sparsely armed with sharp teeth on the posterior margin, and the ischium is armed with one strong sharp tooth near the distal or meral extremity. The third pair is long, reaching by nearly half the length of the animal beyond the apex of the rostrum; the ischium is long, slender, and cylindrical, armed on the posterior margin near the meral joint with one solitary tooth, and the ischio-meral joint is rather more than usually stout; the meros is about a fourth longer than the ischium, and is armed on the posterior margin with three or four sharp teeth distantly situated from each other; the carpos is considerably more slender than the preceding joint, and is about one-fourth longer; the propodos is short and narrow, and the dactylos slender and straight. The fourth and fifth pairs resemble the third, but the joints increase in length in each pair in succession, except the dactylos, which is small and feeble in the fifth pair.

The anterior four pairs of pleopoda are in the typical specimens laden with numerous small ova. The sixth pair helps to form the rhipidura, of which the outer rami are about a millimetre longer than the telson.

The male differs from the female in being smaller and more slender. The rostrum has the same number of spinules and teeth as in the female, and similarly situated, and in most other points the two correspond in relative proportions. Two of the smaller specimens taken at Station 232, which lies between the stations at which the typical

specimens and the nearly allied species *Nematocarcinus parvidentatus* were taken, differ in having the rostrum somewhat shorter than in the more typical form, the apex scarcely reaching beyond the distal extremity of the third joint of the peduncle of the first pair of antennæ; in this variation some approach is made to *Nematocarcinus parvidentatus*.

Nematocarcinus parvidentatus, n. sp. (Pl. CXXXII. fig. 7).

Rostrum horizontal, less than half the length of the carapace, furnished with about two and twenty small teeth and spinules, the spinules being most crowded over the dorsal crest, and the teeth on the rostrum less closely planted. Lower margin unarmed and fringed in its entire length with a row of thickly-set cilia.

Ophthalmus rather smaller than in other species.

Peduncle of the first pair of antennæ subequal in length to the rostrum, and supporting two flagella, very unequal in diameter.

Telson subequal in length to the sixth pleopod, and furnished with a horizontal row of several small spinules placed widely apart on the dorso-lateral angle.

Length, entire (male),	87 mm. (3·4 in.).
„ of carapace,	23 „
„ of rostrum,	9 „
„ of pleon,	64 „
„ of third somite of pleon,	11 „
„ of sixth somite of pleon,	15 „
„ of telson,	13 „

Habitat.—Station 237, June 17, 1875; lat. 34° 37′ N., long. 140° 32′ E.; near Yokohama, Japan; depth, 1875 fathoms; bottom, blue mud; bottom temperature, 35°·3. Nine specimens; four males, five females. Associated with *Nematocarcinus productus*. Trawled.

The specimens are considerably damaged, none of the pereiopoda or antennæ being preserved attached; the rostrum is produced in a line horizontal with the dorsal surface of the carapace, and is armed on the upper surface with about twenty-two spinules, of which the anterior are only imperfectly transformed into teeth; each little spinule has a lobe posterior to it, with which it has an imperfect articulation.

The upper margin is depressed anteriorly, while the lower is straight, so that the apex is formed by the upper surface descending to the lower, which gives it an arched appearance; the frontal margin has a well-developed antennal tooth, but the fronto-lateral tooth appears to be entirely absent.

The ophthalmus is rather smaller than usual and somewhat reniform in shape.

The first pair of antennæ has the first joint of the peduncle deeply excavate, and

armed on the outer surface with a broad sharp-pointed stylocerite; the second and third joints are short and cylindrical, reaching to a level with the apex of the rostrum, and supporting two unequally sized flagella.

The second pair of antennæ carries a scaphocerite that is about half as long again as the rostrum, and slightly tapers to the extremity, where it is abruptly truncated at a level with a small external tooth.

The second pair of gnathopoda reaches to the extremity of the rostrum but falls short of that of the scaphocerite; it has the terminal joint long, narrow, and lanceolate, and nearly as long as the preceding.

All the other appendages are damaged, so as to be valueless in specific diagnosis.

Observations.—The specimens are males and females, and the antero-lateral processes on the ventral plates of the posterior three somites of the pleon are well developed. The pleopoda are long, those of the first pair having the internal or foliaceous petasma broad, while the second pair carries a thick stylamblys attached to the main branch, the third and fourth pairs carrying one that is small and slender.

Nematocarcinus gracilis, n. sp. (Pl. CXXXII. fig. 8).

Body slender, rostrum horizontal and short, being about one-fourth the length of the carapace, and armed on the upper surface with about twenty spinules and teeth and with one large tooth near the apex on the lower margin.

Scaphocerite more than half the length of the carapace, and nearly twice as long as the rostrum.

Third pair of pereiopoda longer than the entire animal.

Telson as long as the outer branch of the rhipidura.

Length, entire (male),	59 mm. (2·3 in.).
„ of carapace,	15 „
„ of rostrum,	4 „
„ of pleon,	44 „
„ of third somite of pleon,	9 „
„ of sixth somite of pleon,	10 „
„ of telson,	11 „

Habitat.—Station 174c, August 3, 1874; lat. 19° 7′ 50″ S., long. 178° 19′ 35″ E.; off Kandavu, Fiji Islands; depth, 610 fathoms; bottom, coral mud; bottom temperature, 39°. Two specimens, males. Associated with *Nematocarcinus paucidentatus* and *Pentacheles*. Trawled.

Station 171, July 15, 1874; lat. 28° 33′ S., long. 177° 50′ W.; north of the Kermadec Islands; depth, 600 fathoms; bottom, hard ground; bottom temperature, 39°·5. One specimen, damaged. Trawled.

The rostrum, which dips downwards a little anteriorly, is armed with sixteen spinules in one specimen, and twenty in another; all the spinules articulate excepting perhaps the first two or three, and even they appear to have a line of articulation, and the posterior margin of each, as well as the lobe to which it is articulated, appears to be thickened for the purpose of supporting a fasciculus of small hairs. On the lower margin, not far from the apex of the rostrum, stands one rigid tooth that is directed straight forwards, and from this the lower margin ascends to the apex.

The ophthalmopoda are three-fourths the length of the rostrum, and the ophthalmus is comparatively large.

The first pair of antennæ has the peduncle a little longer than the rostrum, and the scaphocerite of the second pair is still longer.

The second pair of gnathopoda reaches beyond the extremity of the rostrum but falls short of that of the scaphocerite.

The first pair of pereiopoda is long and slender, and reaches considerably beyond the scaphocerite, the carpos being as long as the ischium and meros together. The second pair is wanting. The third pair is damaged, being broken at the propodal joint of the carpos, from which to the coxa it measures 80 mm., and therefore is nearly five times longer than the entire animal. The fourth pair is broken off, but a detached limb that I take to have belonged to it is correspondingly longer than the third, and resembles it in all points, so far as the two can be compared, excepting that the meros of the detached leg is armed with two rows of distant spines which are more conspicuous than those on the attached limb. The carpos of the detached appendage is as long as the meros and half the ischium.

The anterior plate on the ventral surface of the pereion is very narrow as compared with those posterior to it.

Nematocarcinus paucidentatus, n. sp. (Pl. CXXXII. fig. 9).

Carapace one-third the length of the animal, exclusive of the rostrum and telson; anterior dorsal surface slightly carinated and horizontally produced to a laterally compressed rostrum that is about one-fourth the length of the carapace, armed on the upper surface with nine sharp spinules, and on the lower with one fixed tooth near the apex and a fringe of cilia between.

Pleon from the posterior half of the third somite to the telson laterally compressed. Telson dorsally flattened, and the sides depressed, the longitudinal angle armed with seven or eight small spinules on each side.

Length, entire (male),	100 mm.	(3·9 in.).
„ of carapace,	25	„
„ of rostrum,	6	„
„ of pleon,	75	„
„ of third somite of pleon,	11	„
„ of sixth somite of pleon,	15	„
„ of telson,	15	„

Habitat.—Station 174c, August 3, 1874; lat. 19° 7′ 50″ S., long. 178° 19′ 35″ E.; off Kandavu, Fiji Islands; depth, 610 fathoms; bottom, coral mud; bottom temperature, 39°. One specimen, damaged. Trawled.

The only specimen of this species is unfortunately mutilated, being deprived of all the appendages excepting the smaller ones in relation to the mouth.

The rostrum is horizontal on the upper surface, and armed with nine small articulating spines, while the lower margin is furnished with a tooth near the apex, and a fringe of hairs reaching from it to the base; behind the armature on the dorsal surface the rostral crest continues as a smooth carina to the cervical fossa, at the posterior margin of the gastric region, on each side of which a lengthened oblique lateral protuberance is directed towards the fronto-lateral angle.

The ophthalmopoda extend to about half the length of the rostrum, and support an ophthalmus that is tolerably large and round.

The first pair of antennæ has the stylocerite short, with a terminal sharp tooth; the third joint of the peduncle reaches to a level with the apex of the rostrum.

The second pair of antennæ has the scaphocerite reaching considerably beyond the extremity of the rostrum, and terminating in a squarish extremity.

The pleopoda are long and apparently strong, and exhibit the petasma and stylamblydes common to the males in this genus, without any specific feature.

The telson is damaged.

Nematocarcinus tenuirostris, n. sp. (Pl. CXXXII. fig. 10).

Rostrum one half the length of the carapace, projecting horizontally forwards, slender, styliform, armed on the upper surface with seven points and on the under margin near the apex with one small tooth.

First pair of antennæ having the peduncle one-third shorter than the rostrum, and the flagella two or three times as long as the animal. Second pair of antennæ having the scaphocerite reaching considerably beyond the extremity of the rostrum, and four times the length of the animal.

Second pair of gnathopoda reaching as far as the extremity of the rostrum.

All the other exposed appendages are wanting.

The telson is as long as the sixth somite of the pleon, and equal with the length of the outer plates of the rhipidura.

Length, entire (female),	. . . . .	87 mm. (3·4 in.).
„ of carapace,	. . . . .	24 „
„ of rostrum,	. . . . .	12 „
„ of pleon,	. . . . .	63 „
„ of third somite of pleon,	. . . .	11 „
„ of sixth somite of pleon,	. . . .	14 „
„ of telson,	. . . . .	15 „

Habitat.—Station 174c, August 3, 1874; lat. 19° 7′ 50″ S., long. 178° 19′ 35″ E.; off Kandavu, Fiji Islands; depth, 610 fathoms; bottom, coral mud; bottom temperature, 39°. Two specimens, female. Trawled.

Station 214, February 10, 1875; lat. 4° 33′ N., long. 127° 6′ E.; south of the Philippine Islands; depth, 500 fathoms; bottom, blue mud; bottom temperature, 41°·8. Five specimens. Trawled.

This species is rather slender; the cervical fossa is well defined on the dorsal surface of the carapace, and immediately anterior to it a small crest-like carina commences and runs into the rostrum, which projects horizontally forwards and terminates in a styliform point; the upper surface of this crest is smooth for nearly half its length; the posterior half in advance of the orbit has three long sharp teeth, and posterior to the orbit are four that are closely planted together; these latter are movable spinules, while those on the rostrum are more distant from each other and immovable.

The carapace is ornamented on the dorsal surface with a slight carina commencing anterior to the cervical crest, and armed on the frontal region and upper surface of the rostrum with seven spinules, of which the posterior are closely planted together, the others becoming more and more separated as they approach the apex, which is distant from the most anterior tooth by nearly half the length of the rostrum; the under surface is armed with one small tooth situated about halfway between the apex and the most anterior tooth on the dorsal surface. The frontal margin is furnished with a short, strong, antennal tooth, and a long and slender one at the fronto-lateral margin.

The ophthalmopoda are of moderate proportions, and scarcely more than one-fourth the length of the rostrum.

The first pair of antennæ has the first joint deeply excavate and furnished with a stylocerite that is sharp-pointed and nearly as long as the ophthalmopod; the third or terminal joint of the peduncle reaches to about two-thirds the length of the rostrum, and supports two long flagella, the inner one of which is alone preserved and reaches to rather more than twice the length of the animal, where it is broken off, leaving a stout extremity.

The second pair of antennæ carries a scaphocerite that is about one-fourth longer than the rostrum, and has its sides subparallel and fringed with long hairs. The flagellum in

its present condition is about twice the length of the animal, and is broken off at a point where it is still thick.

The second pair of gnathopoda reaches to a level with the apex of the rostrum.

All the pereiopoda are broken off, but one or two unattached limbs that appear to belong to this species are preserved. They are long, the carpos, probably of the fourth pair, being specially so, very nearly equalling the combined lengths of the meros and ischium; the ischium is slender, cylindrical, 22 mm. long, and armed near the meral joint with two long teeth, one on the upper, the other on the lower and inner surface; the meros is 48 mm. in length, and armed on the upper surface with a row of distant teeth, of which the most anterior stands close to the carpal joint, and a second row of rather smaller teeth, in position intermediate with the others, on the lower; the carpos is 63 mm. in length and 0·2 mm. in diameter, or 7 mm. shorter than the meros and ischium together, it is cylindrical and smooth from the meral to the propodal joint, at which it increases in diameter from one-fourth to one-half of a millimetre; the propodos is 2 mm. long, and increases in diameter from the carpal to the dactylar joint, where it terminates in an oblique margin that is about 0·5 mm. in length; the dactylos is 3 mm. in length and waved as in *Nematocarcinus undulatipes*.

There is also a detached cheliped which I believe to belong to the second pair of pereiopoda of one of the specimens of this species. The several joints have the following dimensions:—carpos, 40 mm.; meros, 28 mm.; ischium, 19 mm.; chela, 4 mm. and 0·8 mm. broad; digits, 1·5 mm. The meros is armed with small teeth and the carpos is smooth.

The penultimate pair of pereiopoda may therefore be considered to be rather more than twice the length of the animal.

The third somite of the pleon does not project much over the fourth, and the posterior somites are not much compressed.

The telson is equal in length to the sixth somite, as well as to the outer rami of the rhipidura.

Nematocarcinus serratus, n. sp. (Pl. CXXXII. fig. 11).

Rostrum more than half the length of the carapace, slightly elevated from the base to the apex, and furnished with thirty-two teeth or spinules on the upper surface and with none on the lower.

Ophthalmopoda rather small.

First pair of antennæ having the peduncle one-third shorter than the rostrum.

Second pair of antennæ having the scaphocerite subequal to or scarcely longer than the rostrum.

Telson wanting.

Length, entire (female),	100 mm. (3·9 in.).
„ of carapace,	26 „
„ of rostrum,	15 „
„ of pleon,	74 „
„ of third somite of pleon,	14 „
„ of sixth somite of pleon,	15 „
„ of telson,	15 „

Habitat.—Station 169, July 10, 1874; lat. 37° 34′ S., long. 179° 22′ E.; off New Zealand; depth, 700 fathoms; bottom, blue mud; bottom temperature, 40°. One specimen. Associated with *Acanthephyra purpurea*. Trawled.

The rostrum gradually slopes upwards from a dorsal carina that commences at the scarcely distinguishable cervical fossa, and continues smooth to the frontal crest, where it is furnished with a series of spinules that are persistent to the apex; the lower margin is smooth throughout its length, and is fringed with hairs from base to apex. The regions of the carapace are but imperfectly defined, and the frontal margin is furnished with a tooth at the antennal and fronto-lateral angles.

The ophthalmopoda are rather small.

The first pair of antennæ has the peduncle shorter than the rostrum by one-third of its length, and supports a sharp-pointed stylocerite that reaches to the distal extremity of the ophthalmus.

The second pair of antennæ has a scaphocerite that is subequal in length with the rostrum.

The second pair of gnathopoda does not reach to the extremity of the rostrum.

The first pair of pereiopoda reaches by the length of the propodos beyond the extremity of the scaphocerite; it has the carpos smooth, the meros armed with two teeth, of which the anterior stands near the middle, and the posterior halfway between it and the ischial articulation; the ischium is furnished with two teeth on the inner side near the meral articulation, and one at the base near the basisal articulation. The other pereiopoda are broken off, but one of the fourth pair has the ischial joint attached, and a detached leg is present in the same bottle, broken off at the ischial articulation, and therefore probably the other part of it. As compared with that of some other species it is rather short, the carpos being not one-third longer than the meros, which is sparsely armed with a few sharp teeth; the propodos is slender and the dactylos slightly waved.

The pleon is laterally compressed and has the third somite rather long and somewhat produced over the fourth.

The rest of the animal is too imperfect for description, since the posterior moiety of the pleon and the rhipidura are broken off.

Nematocarcinus hiatus, n. sp. (Pl. CXXXII. fig. 12).

There is only a fragment of this species. The carina on the gastric region of the carapace is feeble ; the frontal crest is adorned with six spinules, and after a short hiatus there are twenty-three or twenty-four teeth continuous as far as the broken extremity of the rostrum ; on the lower margin there are six teeth, of which the anterior corresponds with the fracture.

The ophthalmopoda are short.

The first pair of antennæ has the peduncle reaching to about half the length of the rostrum.

The second pair of antennæ has a scaphocerite reaching as far as the fractured extremity of the rostrum, and it therefore falls short of the apex in a perfect specimen.

The first pair of gnathopoda is preserved, but there is nothing to enable us to determine the character of the fragment beyond the form of the rostrum. In the number of the teeth on the rostrum this species approximates to *Nematocarcinus longirostris*, but the free length of the unarmed portion in *Nematocarcinus longirostris*, and the appearance and position of the teeth on the lower margin, at once show that the two are distinct.

Length of carapace, ...	18 mm. (0·7 in.).
„ of rostrum (broken), ...	12 „

Habitat.—Station 169, July 10, 1874 ; lat. 37° 34′ S., long. 179° 22′ E.; off New Zealand ; depth, 700 fathoms ; bottom, blue mud ; bottom temperature, 40°. A fragment only. Trawled.

Nematocarcinus intermedius, n. sp. (Pl. CXXXII. fig. 13).

Rostrum two-thirds the length of the carapace, armed on the upper surface with very small spinules, twelve or thirteen of which are closely planted together on the dorsal crest, and eleven or twelve more widely separated from each other and continuous to the apex.

Ophthalmopoda tolerably large.

First pair of antennæ having the peduncle about half the length of the rostrum.

Second pair of antennæ having the scaphocerite reaching to a level with the apex of the rostrum.

Second pair of gnathopoda not reaching as far as the extremity of the scaphocerite.

Posterior three pairs of pereiopoda having the carpos as long as the ischium and meros combined ; that of the preceding pairs is shorter.

Telson as long as the sixth somite, tapering, furnished with seven separate, minute spinules on the dorso-lateral angles, and subequal in length with the outer rami of the rhipidura.

The male is more slender, but corresponds with the female in general features.

	Female.	Male.
Length, entire, . . .	110 mm. (4·3 in.).	91 mm. (3·5 in.).
„ of carapace, . .	32 „	25 „
„ of rostrum, . .	22 „	? „
„ of pleon, . . .	78 „	66 „
„ of third somite of pleon, .	14 „	13 „
„ of sixth somite of pleon, .	19 „	16 „
„ of telson, . . .	19 „	16 „

Habitat.—Station 218, March 1, 1875; lat. 2° 33′ S., long. 144° 4′ E.; off New Guinea; depth, 1070 fathoms; bottom, blue mud; bottom temperature, 36°·4. Two specimens; one male, one female. Trawled.

This species corresponds in several respects with *Nematocarcinus productus* and *Nematocarcinus parvidentatus*, but differs in the relative lengths of the rostrum and carapace, as may be seen from the measurements given under each species.

Thus in *Nematocarcinus intermedius* the rostrum is two-thirds the length of the carapace, one-half in *Nematocarcinus productus* and about one-third in *Nematocarcinus parvidentatus;* on the shortest rostrum there are twenty-two teeth, and on the longest there is just the same number, although the rostrum is three times as long.

I am therefore compelled in the present state of our knowledge to consider the three to be distinct species.

The male specimen has the rostrum broken, which is to be regretted, since I am therefore unable to compare it with a smaller specimen that was taken in the same haul, and which I believe to belong to *Nematocarcinus tenuipes*, which differs from *Nematocarcinus parvidentatus* in the possession of a small tooth on the under surface of the rostrum near the apex, a feature that I sometimes think may be sexual rather than specific.

Stochasmus,[1] n. gen.

Carapace one-third the length of the animal, dorsally compressed anteriorly, and produced to a rostrum that is armed with a series of spinules on the upper surface; furnished on the frontal margin with an antennal tooth and with one at the fronto-lateral angle.

Pleon laterally compressed and dorsally smooth. First somite as deep as the second,

[1] στοχασμὸς, a conjecture.

third somite projecting slightly over the anterior dorsal margin of the fourth. Sixth somite about twice as long as the fifth.

Telson nearly as long as the sixth somite, and furnished at the dorso-lateral margin with a longitudinal series of distant spinules.

First pair of antennæ having the peduncle subequal in length with the rostrum, and carrying two unequal long flagella.

Second pair of antennæ armed with a tooth at the lower distal extremity of the first joint, and carrying a scaphocerite that is subequal with the rostrum and armed with a stout tooth at the outer distal extremity.

Second pair of gnathopoda having the several joints long, and terminating in a slender curved dactylos.

Observations.—There is only one specimen of this genus in the collection, and that is imperfect. It corresponds with *Nematocarcinus* in all respects, excepting in the form of the second pair of gnathopoda.

Stochasmus exilis, n. sp. (Pl. CXXXII. fig. 14).

Carapace about one-third the length of the animal, having a rostrum about one-third the length of the carapace, and armed with more than twenty long spinules closely pressed together on the upper surface, and none upon the lower. The antennal tooth is long and slender and that at the fronto-lateral angle is short.

The ophthalmopoda are short.

The first pair of antennæ has the peduncle subequal with the rostrum; the first joint is excavate on the upper surface, and has a sharp-pointed stylocerite that is about half the length of the joint; it terminates in two long flagella.

The second pair of antennæ has the coxa armed with a long tooth on the lower distal angle, and carries a scaphocerite that reaches considerably beyond the apex of the rostrum and terminates in a tooth on the outer distal angle.

The second pair of gnathopoda is long and slender, reaching nearly to the extremity of the rostrum; it has a long meral joint, a long and slender carpos, and a propodos that is long and compressed, fringed with hairs on either side, and terminating in a narrow extremity that articulates with a curved and slender dactylos.

The pleon is laterally compressed and has the third somite posteriorly produced to a point on the dorsal surface. The sixth somite is about twice the length of the preceding.

The telson is nearly as long as the sixth somite, and is furnished on each side with six dorso-lateral spinules, with two long spines at the outer angles of the terminal extremity, and with several intermediate stiff hairs.

Length, entire,	. . . . .	41 mm. (1·6 in.).
„	of carapace, ...	11 „
„	of rostrum, ...	4 „
„	of pleon, ...	30 „
„	of third somite of pleon, ...	6 „
„	of sixth somite of pleon, ...	9 „
„	of telson, ...	8 „

Habitat.—Station 84, July 18, 1873; lat. 30° 38′ N., long. 18° 5′ W.; off the Canary Islands; depth and bottom not recorded. One specimen.

Unfortunately only one very imperfect specimen was obtained; all the pereiopoda are gone, and its relation to *Nematocarcinus* can therefore only be conjectured, but, as it differs in the important character of having a dactylos attached to the extremity of the second pair of gnathopoda, it is impossible to associate it with any species of that genus. In the other details of the portions preserved it closely resembles *Nematocarcinus*, differing from *Nematocarcinus cursor*, A. Milne-Edwards, only in the number and character of the spines on the rostrum.

Notostomus, A. Milne-Edwards.

Notostomus, A. Milne-Edwards, Ann. d. Sci. Nat., sér. 6, tom. xi. p. 7, 1881.

This genus was described by A. Milne-Edwards from specimens taken by Professor Agassiz in the neighbourhood of the West Indian Islands, but some specimens were previously taken by the Challenger, figured, and ready for publication. It is closely allied in structural characters to *Acanthephyra*, and is only separated by the convenience of classification in consequence of the external form of the carapace, which exhibits the carinated features as seen in the genus *Heterocarpus*, with which its branchial arrangement also corresponds.

The body of the animal is not very much compressed laterally, except along the dorsal ridge, which is elevated into a carina following the contour of the animal from the rostrum to the telson. From the apex of the rostrum, corresponding with its infero-lateral margin, a second carina longitudinally traverses the surface of the carapace along the upper line of the branchial region to the posterior margin of the carapace. The dorsal surface of the carapace is arched, especially over the frontal and gastric regions; the rostrum is horizontally straight.

The ophthalmopoda are widely separated at their base, and carry a large ophthalmus at their extremity.

The first pair of antennæ has the peduncle shorter than the rostrum, the first joint being long and excavate on the upper surface to receive the ophthalmopod, and carries a short, broad, and pointed stylocerite. The two following joints are short and carry one stout and one slender flagellum, the former gradually tapering to a fine extremity.

The second pair of antennæ has the peduncle robust, and carries a broad scaphocerite that is rounded at the extremity, and armed on the outer distal margin with a strong tooth.

The mandibles have a large and broad psalistoma that is slightly serrate, and continuous with a small, smooth, lunate, molar process, and carry a stout three-jointed synaphipod, of which the terminal joint is short and spatuliform.

The three pairs of siagnopoda correspond generically with those of *Acanthephyra*, as do also most of the other appendages, such variations only existing as may be supposed to accord with specific changes.

A. Milne-Edwards says that "the first pair of pereiopoda is longer than the second; they are both didactyle," but in all our specimens of the several species the first pair of pereiopoda is shorter than the second. The third and fourth pairs of pereiopoda are long, and have the propodos more slender than the preceding joints, and the dactylos long, styliform, and slightly curved; the fifth pair resembles the two preceding, but terminates in a short, almost obsolete, dactylos, embedded in a thick brush of ciliated hairs.

The pleon has the dorsal surface strongly carinated, and is generally produced to a tooth on the third and following somites.

The telson is dorsally flat or grooved, and does not extend beyond the length of the inner plates of the rhipidura.

A. Milne-Edwards says that "the rostrum is remarkably short and slender, and carries about eight teeth above and the same below; it does not reach beyond the scaphocerite." This is correct of four out of five of the Challenger species, but *Notostomus longirostris*, as well as his own *Notostomus elegans*, has the rostrum longer than the scaphocerite, and all our specimens have the dentation on the former more abundant than described by A. Milne-Edwards from his type, *Notostomus gibbosus*.

There are several details in the above description which disagree with that given by A. Milne-Edwards, above quoted, but I have had the opportunity of showing the plates of this work to that author, and also of examining the animals from which his description was taken, and I feel assured that the various forms belong to the genus he has described, and I therefore adopt the name that he has proposed.

The branchiæ closely agree with those of *Acanthephyra*. The several pleurobranchiæ are implanted so near the pereiopodal articulation, that it was only in the larger specimens I could be certain that they do not spring from the articulating membrane. The plumes are well formed and not so much laterally compressed, more especially the pleurobranchiæ, as in *Acanthephyra*.

The branchial arrangement of this genus is shown in the following table:—

Pleurobranchiæ,	...	1	1	1	1	1	1
Arthrobranchiæ,	...	1	1	1	1	1	...
Podobranchiæ,	1	...	...	...	...	...	...
Mastigobranchiæ,	1	1	1	1	1	...	...
	h	i	k	l	m	n	o

The pleopoda in all except the first pair consists of two long, narrow, flat branches, of equal length and fringed with ciliated hairs; to the inner side of the anterior branch is attached a long stylamblys, whereas in the first pair of the male the inner branch is reduced to a small, rudimentary, membranous plate.

Geographical Distribution.—The range of this genus is extensive in area and variable in depth. In the West Indies it was taken by Professor Agassiz off Grenada, at a depth of 626 fathoms, and in the Sea of Antilles at a depth of 955 fathoms. The several specimens in the Challenger collection were taken at depths varying from 2150 fathoms to about 500, but it appears to me that *Notostomus* must be considered to be a deep-sea form, inasmuch as those localities in which it was got in a depth less than 1000 fathoms were in the vicinity of deeper water. On the southern coast of Japan, where *Notostomus japonicus* was taken, the station was on the verge of the 1000-fathoms line, beyond which the water rapidly deepens to 2000 and 3000 fathoms. So again on the eastern coast of South America, the soundings north and south show that the Atlantic in this region deepens very rapidly to 1000 and 2000 fathoms. In the Sea of Banda and off the Island of Celebes, specimens were brought up from a depth of 1425 fathoms and 2150 fathoms respectively.

The range in area of this genus is very great and almost cosmopolitan. It has been taken in the Atlantic among the West Indian Islands, off the eastern coast of South America, and in the middle of that ocean as far south as Tristan da Cunha. In the east it has been taken in the sea south of New Guinea, along the coast of Celebes, and as far north as Japan.

Notostomus patentissimus, n. sp. (Pl. CXXXIII.; Pl. CXXXIV. figs. 1, 2).

Carapace arcuate, dorsally carinated from the posterior margin to the rostrum, which is short, and horizontally straight. The lateral walls of the carapace are traversed on each side by five longitudinal carinæ, three of which extend from the frontal to the posterior margin, and the other two commence at the anterior margin of the branchial region and terminate in the posterior margin of the carapace.

Pleon arched and dorsally carinated; first two somites carinated but not dentate, the four following all carinated and posteriorly produced to a strong dorsal tooth.

Telson laterally compressed, dorsally grooved, and subequal with the inner, but not so long as the outer, plates of the rhipidura.

Ophthalmopoda pyriform.

First pair of antennæ about as long as the carapace.

Second pair of antennæ about as long again as the animal and carrying a scaphocerite that is broader at the base than at the distal extremity, which reaches considerably beyond the apex of the rostrum, and is armed on the outer margin with a conspicuous tooth.

Second pair of gnathopoda reaching slightly beyond the extremity of the scaphocerite, and terminating in a sharp oblique point.

First pair of pereiopoda slightly broader than the second. Third and fourth pairs having the propodos long, slender, and cylindrical, and the dactylos long and styliform. Fifth pair shorter than the preceding, and formed on the same plan, but terminating in a short, almost immature, dactylos, that is hidden in a brush of hairs.

The pleopoda are flat, narrow, and pointed.

Length, entire,	109 mm. (4·2 in.).
„ of carapace,	45 „
„ of rostrum,	10 „
„ of pleon,	64 „
„ of third somite of pleon,	13 „
„ of sixth somite of pleon,	9 „
„ of telson,	17 „

Habitat.—Station 198, October 20, 1874; lat. 2° 55′ N., long. 124° 53′ E; south of the Philippine Islands; depth, 2150 fathoms; bottom, blue mud; bottom temperature, 38°·9. One specimen; female. Trawled.

The carapace has a dorsal carina and is suddenly elevated from the base of the rostrum, especially over the frontal region; the rostrum is slender and narrow, not reaching so far as the extremity of the scaphocerite, and furnished on the lower margin with seven or eight minute teeth, and on the upper surface with a considerable number of still smaller teeth, which extend from the apex to the posterior margin of the carapace. From the upper margin of the rostrum a small ridge extends on each side and is lost at a point about halfway between the orbit and the dorsal carina. From the lower margin of the rostrum another ridge passes backwards and outwards, and terminates between the orbit and just above the anterior extremity of the orbital carina, but is not confluent with it. The orbital carina commences immediately behind the ophthalmopod where it is continuous with the inferior and outer margin of the orbit, forming a notch between it and the upper or inner margin; from its commencement the ridge continues horizontally in a line along the upper margin of the branchial region to the posterior margin of the carapace. Corresponding with a depression of the hepatic region is an oblique transverse ridge—a line of muscular attachment that connects the cephalon with the pereion—which extends from the orbital and connects it with the outer antennal carina. The latter ridge commences in a prominent style-like tooth on the outer side of the second pair of antennæ, and terminates in the posterior margin of the carapace, forming a line parallel with the orbital carina. An intermediate carina between the orbital and outer antennal commences at the posterior margin, close to the termination of the orbital carina, but not confluent with it, and may conveniently be termed a semicarina; it proceeds downwards and then forwards in a line parallel with it until within a short distance of the transverse

hepatic ridge, where it terminates somewhat abruptly, corresponding almost completely with the length of the branchial region. Inferiorly, or below the antennal carina, is another that commences almost in connection with it, close to the posterior margin, following the curve of the postero-lateral margin of the carapace and then running parallel with the antennal carina, and dying out just before reaching the anterior margin. Another carina, the fifth on the same side, commences in the posterior margin, confluent with the antennal carina, and follows a line within, but subparallel to, the inferior margin of the carapace. These several carinæ, eleven in all including the dorsal, are more or less constant in the several species, and form a peculiar feature in the genus.

The first somite of the pleon has the anterior division strongly defined from the posterior, the dorsal surface of which is elevated, slightly carinated, and the posterior margin deeply notched in the median line. The lateral or coxal plates are very large and deep, the anterior being deeper in this species than in most others, and are broader at the inferior margin than at the dorsal surface of the somite. The infero-anterior angle projects forwards, and the anterior margin overlaps the sides of the carapace, the dorsal portion of which falls into the deep depression formed between the anterior and posterior division of the first somite of the pleon. The third and following somites have the two divisions confluent; the dorsal median line is carinated and the posterior margin is produced to a sharp-pointed tooth in all except the first two, which are regularly notched, the second somite not being quite so strongly excavate as the first.

The telson is dorsally grooved and laterally compressed, the margins being smooth and unarmed.

The whole surface of the animal is covered with small irregular corrugations, which, so far as I have observed, is a feature peculiar to this genus.

The ophthalmopoda stand near the margin of the carapace at the extremities of the ophthalmic somite, and are consequently placed widely apart at their base; they are pyriform and furnished on the inner side halfway between the articulation and the ophthalmus with a small bead-like tubercle. The ophthalmus is black and the margin even, except on the posterior side, where a small excavation exists producing a prominent point somewhat like an ocellus, but not structurally separate from the ophthalmus.

The first pair of antennæ has the first joint excavate to receive the eyes, and carries a sharp-pointed stylocerite; the two succeeding joints are short, and the last supports two unequal flagella that are longer than the carapace.

The second pair of antennæ carries a scaphocerite that reaches a little beyond the rostrum, terminates in a rounded apex, and is furnished on the external margin with a sharp tooth. The tooth on the under surface of the second joint is short and pointed.

The oral appendages offer nothing characteristically distinct from those of other species.

The second pair of gnathopoda is tomentose, as are, to a slight degree, all the appendages of the pereion. It appears to consist of only five joints, the ischium and

Notostomus japonicus, n. sp. (Pl. CXXXV. fig. 1).

Carapace having the dorsal carina horizontal and but little elevated, serrate along the surface from the posterior extremity to the anterior (the rostrum is broken off just anterior to the ophthalmopoda). Each lateral surface has three carinæ; the semicarina is represented by a longitudinal groove parallel with the posterior half of the orbital carina. The inner orbital margin is not confluent with the orbital carina, and a small ridge runs from the upper margin of the rostrum and dies out above the fronto-lateral region.

The first pair of antennæ has a long and sharp stylocerite; the outer flagellum is broad and flat towards the base, and then narrows abruptly to a slender termination.

The second pair of antennæ carries an ovate scaphocerite that is armed on the outer distal margin with a long and sharp tooth.

The telson is dorsally grooved in its entire length, and is shorter than the inner lateral plate of the rhipidura.

Length, entire (male),	114	mm. (4·5 in.).
„ of carapace,	42	„
„ of rostrum,	?	„
„ of pleon,	72	„
„ of third somite of pleon,	12	„
„ of sixth somite of pleon,	11	„
„ of telson,	22	„

Habitat.—Station 235, June 4, 1875; lat. 34° 7′ N., long. 138° 0′ E.; south of Japan; depth, 565 fathoms; bottom, green mud; bottom temperature, 38°·1. One specimen, male. Trawled.

This species is rather more compressed and less elevated dorsally than the other species; the median carina is nearly straight, and the outer antennal carina is more than usually distant from the orbital, and is nearly parallel with the inferior margin of the carapace.

The rostrum is broken off in the only specimen taken.

The surface of the animal is corrugated all over, more coarsely on the pleon and dorsal surface of the carapace than along the lateral walls. The broad ventral plate-like surface posterior to the last pair of pereiopoda is shorter than in female forms; the inner branch of the first pair of pleopoda is broad, short, and submembranous, having the stylamblys reduced and closely associated with its margin, the extremity furnished with numerous cincinnuli, and the margin with short stiff spines.

The specimen may not improbably have been a wanderer from deeper water, since where it was taken the ocean rapidly deepens from the 100-fathom coast-line to 3000 fathoms; and the bottom temperature was only 0°·1 above that at 1425 fathoms at Station 195 in the Sea of Banda.

Notostomus perlatus, n. sp. (Pl. CXXXIV. fig. 2).

Carapace having the dorsal surface deeply carinated, arched, and produced anteriorly to a short, slender, straight rostrum, armed on the lower margin with five small denticles, and on the upper with numerous smaller ones that are constant along the dorsal carina to the posterior margin of the carapace. From the side of the rostrum a small carina starts, and uniting with the orbital carina just behind the orbit, continues prominent to the posterior margin of the carapace. A small and unimportant carina commences at the posterior margin just below the orbital carina, and runs near and subparallel to it for a short distance, and then dies out. From the second antennal tooth a carina runs slightly downwards to the posterior margin, and between this and the inferior margin of the carapace there exists the trace of a submarginal ridge. From the orbital to the outer antennal carina a vertical ridge runs slightly obliquely downwards and backwards, being formed by a sudden depression of the hepatic region. The lateral walls of the carapace in this species therefore exhibit two obscure and two well-defined carinæ on each side, or nine in all.

The carapace is smooth and the pleon corrugated; the latter has all the somites carinated, and the four posterior produced into well-defined teeth, of which that on the third somite is larger than either of the three following.

The telson is dorsally flattened and laterally compressed, and terminates in a sharp point.

Length, entire,	111 mm. (4·3 in.).
„ of carapace,	52 „
„ of rostrum,	7 „
„ of pleon,	59 „
„ of third somite of pleon,	12 „
„ of sixth somite of pleon,	10 „
„ of telson,	19 „

Habitat.—Station 198, October 20, 1874; lat. 2° 55′ N., long. 124° 53′ E.; near the Philippine Islands; depth, 2150 fathoms; bottom, blue mud; bottom temperature, 38°·9. One specimen, female. Trawled.

This species in general aspect resembles *Notostomus patentissimus*, from which it may, however, be easily distinguished by its shorter rostrum, smooth carapace, the smaller number of carinæ and the larger dorsal teeth on the pleon.

On close inspection there are observable other points of variation that are worthy of consideration.

The lateral carina that starts from the infero-lateral margin of the rostrum agrees with the description of *Notostomus gibbosus* as given by A. Milne-Edwards,[1] in being

[1] *Ann. d. Sci. Nat.*, sér. 6, tom. xi. p. 7.

continuous to the posterior margin of the carapace, whereas in *Notostomus patentissimus* it terminates just behind the orbit, while the orbital carina, which commences just below it in the lower or outer margin of the orbit, proceeds independent of the rostral carina, there being a notch separating the two, to the posterior margin of the carapace. A close inspection of *Notostomus perlatus* shows that the orbital carina, although connected with the rostral carina, yet branches off into a second less important ridge to the outer canthus of the orbit; in the depression between the two carinæ the opththalmopod is capable of being lodged when thrown backwards, and is thus protected, while at the same time a more extensive range of vision is obtained.

The outer and upper flagellum of the first pair of antennæ is not quite so broad as in the preceding species, and the stylocerite is shorter, while the flagellum of the second pair is longer, and the scaphocerite more ovate, being shorter and broader, and also narrower at the apex. The rest of the animal corresponds very closely with the generic condition.

Notostomus brevirostris, n. sp. (Pl. CXXXIV. fig. 3).

Carapace corrugated on the surface, dorsally arched, and laterally compressed to a carina that reaches to near the extremity of the rostrum, which is short, and armed with five small denticles below and a series above, of which only three are on the rostrum, the rest being on the dorsal carina and continuous to the posterior margin of the carapace. The lateral carinæ are as in *Notostomus perlatus*.

The pleon is dorsally carinated, and the four posterior somites are each produced posteriorly to a strong tooth.

The telson is dorsally fluted and tapers gradually to a point that reaches as far as the extremities of the outer plates of the rhipidura.

Length, entire,	150 mm. (6·0 in.).
„ of carapace,	60 „
„ of rostrum,	5 „
„ of pleon,	90 „
„ of third somite of pleon,	13 „
„ of sixth somite of pleon,	13 „
„ of telson,	24 „

Habitat.—Station 120, September 9, 1873; lat. 8° 37′ S., long. 34° 28′ W.; off Pernambuco; depth, 675 fathoms; bottom, red mud. One specimen. Trawled.

This species bears a close resemblance to *Notostomus perlatus*, but the only specimen we possess has the rostrum a little shorter and less sharp; in *Notostomus perlatus* the little denticles are coarser on the rostrum and more closely implanted on the fronto-

dorsal crest, but the specimens as a whole are so closely allied that it is difficult to consider them as being more than varieties of the same species, and they both appear to differ from the description given of *Notostomus gibbosus* by A. Milne-Edwards only in the unimportant feature of the small denticles on the rostrum, more especially on the under side. It appears to me probable that the three forms belong to the same species, but, in the present condition of zoology, it is very desirable that forms found in very distant localities, though resembling each other in general aspect, should have their details and points of distinction clearly determined. This form was taken off the eastern coast of South America, near Pernambuco, in 675 fathoms; *Notostomus gibbosus* was taken off Grenada, in the West Indies, at 626 fathoms, and *Notostomus perlatus* was procured off the Island of Celebes, at 2150 fathoms, a depth of about two miles and a half.

Notostomus longirostris, n. sp. (Pl. CXXXV. fig. 4).

Carapace more arched posteriorly, and less over the frontal region than in *Notostomus patentissimus* or *Notostomus perlatus;* laterally marked with four long carinæ and one semi-carina. Rostrum as long as the carapace. The dorsal carina is furnished with minute denticles from the posterior margin of the carapace to the extremity of the rostrum, gradually increasing in size as they advance anteriorly; the under surface is armed with fourteen teeth, which are rather larger than those on the upper surface.

Telson equal in length to the outer plates of the rhipidura, dorsally grooved, laterally depressed, the longitudinal ridges between the depressions and the dorsal groove being furnished with three or four distant minute spinules.

Length, entire,	64 mm. (2·5 in.).
„ of carapace,	19 „
„ of rostrum,	11 „
„ of pleon,	45 „
„ of third somite of pleon,	7 „
„ of sixth somite of pleon,	5 „
„ of telson,	9 „

Habitat.—Station 195, October 3, 1874; lat. 4° 21′ S., long. 129° 7′ E.; off Banda Island; depth, 1425 fathoms; bottom, blue mud; bottom temperature, 38°. One specimen, male. Trawled.

This species corresponds in many respects with A. Milne-Edwards' description of *Notostomus elegans*, and is an intermediate form between it and *Notostomus murrayi*. It has the rostrum half as long again as the scaphocerite, and has fourteen teeth on the lower surface. It has the dorsal carina more arched towards the posterior or cardiac region, and less so anteriorly, and has four lateral carinæ instead of two.

Tropiocaris,[1] n. gen.

Carapace one-fourth the length of the animal; anteriorly produced to a keel-shaped rostrum that reaches a little beyond the frontal margin.

Pleon laterally compressed and slightly carinated, with a tendency to be posteriorly produced on the dorsal surface into sharp teeth.

Telson long, narrow, and tapering.

Ophthalmopoda pyriform.

First pair of antennæ having the peduncle short and supporting two flagella.

Second pair of antennæ carrying a tapering scaphocerite, furnished with a small tooth on the external distal angle, and terminating in a long and slender flagellum.

Oral appendages not examined.

Second pair of gnathopoda long and slender.

First and second pairs of pereiopoda chelate. Three following pairs terminating in a long, smooth propodos and styliform dactylos, and the fifth has the propodos long, armed with a row of short spines, which culminate towards the distal extremity, and terminate in a short dactylos.

Observations.—This genus in many of its parts approximates so nearly to *Acanthephyra* and *Notostomus* that it can only be considered as a separate genus for the convenience of classification. The three genera agree in the most essential points of their structure, but differ in points that readily attract notice.

In *Notostomus* the carapace is dorsally carinated and elevated, and the rostrum produced to a sharp point that reaches to a greater or less extent beyond the peduncle of the first pair of antennæ, and the lateral walls of the carapace that cover the branchial chambers are strengthened by several strongly marked carinæ.

In *Acanthephyra* the dorsal surface of the carapace is not elevated, and only carinated anteriorly. The rostrum is longer than the peduncle of the first pair of antennæ, and is generally coarsely serrate with teeth that are not continued posteriorly to the gastric region, and there are no carinæ over the branchial regions.

In *Tropiocaris* the carapace is not dorsally elevated, but strongly compressed anteriorly to a deep ridge, at the extremity of which the rostrum projects to a point, and from its base the inferior margin on each side diverges to the orbit, and forms a surface that overhangs the metope or facial wall as a sort of pent-house or hood. There is no carina on the branchial regions, and the posterior dorsal or cardiac region is smooth. The pleon, as in the two preceding genera, is dorsally carinated and posteriorly projects into tooth-like prolongations.

The branchiæ are arranged in the same manner as in *Acanthephyra*, but the

[1] τρόπις, a keel; καρις, a shrimp.

mastigobranchiæ in *Tropiocaris* are rather large, and project further between the branchial plumes; their arrangement is shown in the following table:—

Pleurobranchiæ,	...	...	1	1	1	1	1	
Arthrobranchiæ,	...	1	1	1	1	1	...	
Podobranchiæ,	1	...	...	...	...	...	...	
Mastigobranchiæ,	1	1	1	1	1	...	...	
	h	i	k	l	m	n	o	

Geographical Distribution.—Our typical species was found about twelve degrees south of Japan, and *Tropiocaris tenuipes* at the western entrance of Torres Strait.

Tropiocaris planipes, n. sp. (Pl. CXXXVI. fig. 1).

Dorsal surface of the carapace horizontally straight, subcarinated, produced to a laterally compressed rostrum equal with the first joint of the first pair of antennæ.

Pleon compressed, not carinated, third somite posteriorly projecting in the dorsal median line as a depressed tooth; all the other somites smooth.

Ophthalmopoda short and stout, having no tubercle on the inner surface; ophthalmus larger in diameter than the stalk, black in colour.

First antennæ having the peduncle short and deeply excavate; the outer flagellum stout and the inner slender.

Second pair of antennæ having the scaphocerite longer than the peduncle of the first pair.

Second pair of gnathopoda reaching as far as the extremity of the scaphocerite.

Pereiopoda all having the meros and ischium laterally compressed and broadly dilated.

Telson long, slender, and tapering, the sides being fringed with a row of numerous fine teeth.

Length, entire,	57 mm. (2·2 in.).
„ of carapace,	15 „
„ of rostrum,	3 „
„ of pleon,	42 „
„ of third somite of pleon,	8 „
„ of sixth somite of pleon,	10 „
„ of telson,	12 „
„ of fifth pereiopod,	25 „
Diameter of meros of fifth pereiopod,	3 „

Habitat.—Station 230, April 5, 1875; lat. 26° 29′ N., long. 137° 57′ E.; depth, 2425 fathoms; bottom, red clay; bottom temperature, 35°·5. One specimen, female. Trawled.

The dorsal surface of the carapace is carinated anteriorly and horizontally produced to a laterally compressed rostrum, which is slightly elevated anteriorly, and terminates in a

sharp tooth-like point, whence the lower margin recedes obliquely in an outwardly curved line to the orbit.

The pleon is not carinated, and the third somite is posteriorly produced to a point or depressed tooth in the median line; the other somites are smooth.

The ophthalmopoda are short and robust, having a short thick tubercle on the inner surface, distinct from the ophthalmus, which is black in colour and larger in diameter than the stalk.

The first pair of antennæ has the peduncle short and the first joint deeply excavate; the outer flagellum is very large and the inner slender.

The second pair of antennæ has a scaphocerite that is longer than the peduncle of the first pair.

The first pair of gnathopoda is subpediform and has the terminal joints reflexed.

The second pair of gnathopoda is pediform and reaches beyond the distal extremity of the scaphocerite.

The first pair of pereiopoda is chelate, the meros being long, broad, and transversely compressed; the second pair is longer than the first and also has the meros long and laterally compressed. The three following pairs are not much longer than the second; the third and fourth have the meros long, broad, and of great tenuity.

The first pair of pleopoda has the inner branch reduced to a rudimentary subfoliaceous petasma; all the others have the rami subequal, those of the posterior pair helping to form the rhipidura.

The telson is longer than the inner branch of the sixth pair and subequal with the outer; the dorso-lateral angle is fringed with a series of minute spinules.

Tropiocaris tenuipes, n. sp. (Pl. CXXXVI. fig. 2).

Rostrum anteriorly produced to a level with the distal extremity of the first joint of the first pair of antennæ, dorsal surface armed with four or five distantly placed minute denticles; first antennal tooth reduced to a minimum, second antennal tooth small.

Pleon carinated from the third to the sixth somites; third somite posteriorly produced to a dorsal tooth; the three following terminating abruptly or with a minute projection.

The appendages of the only specimen are very much damaged.

Length, entire,	55	mm. (2·1 in.).
„ of carapace,	20	„
„ of pleon,	35	„
„ of third somite of pleon,	8	„
„ of sixth somite of pleon,	8	„
„ of telson,	8	„
Diameter of meros of fifth pereiopod,	0·8	„

Habitat.—Station 184, August 29, 1874; lat. 12° 8′ S., long. 145° 10′ E.; depth, 1400 fathoms; bottom, Globigerina ooze; bottom temperature, 36°. One specimen, male. Trawled.

This species differs from *Hymenodora mollis* in having the dorsal crest and rostrum more compressed laterally, and anteriorly elevated to a horizontal line with the dorsum. The denticles are very minute, fewer in number, and more distantly separated from each other, and in our specimen have the appearance of being worn. The orbit exists as a well-defined notch without any tooth at the outer canthus, the tooth beyond, which is the first antennal tooth, is apparently worn and exists as a rudiment only, whereas the second antennal tooth is short and more clearly defined, and projects anteriorly outwards from the frontal margin; posteriorly the lateral margin overlies the first somite of the pleon, and is reduced to an extreme degree of tenuity.

The first two somites of the pleon are dorsally rounded and smooth, and are divided into an anterior and a posterior section; the lateral plates are of extreme tenuity and are broadly developed, that of the second overlapping the first. The third somite is dorsally slightly carinated, and posteriorly produced to a sharp tooth; the fourth, fifth, and sixth are feebly carinated and terminate abruptly, or in the most minute tooth-like projections.

The ophthalmopoda are shorter than the rostral projection, pyriform, and but little if at all compressed; the tubercle on the inner surface is reduced to a minimum, and situated close to the ophthalmus.

The first pair of antennæ has the peduncle short, but longer than the rostrum; the first joint is rather deeply excavate to permit the ophthalmopod to rest in the hollow; the second and third joints are very short and cylindrical, and support two unequal flagella of the ordinary character in the species of this genus. The stylocerite is nearly as long as the first joint and sharp-pointed.

The second pair of antennæ has the scaphocerite slightly tapering, of great tenuity, and furnished with a small denticle on the outer distal extremity, the two joints of the peduncle that succeeds the articulation of the scaphocerite are unequal in length, the distal being the longer and more robust. The flagellum is wanting.

The mandible and oral appendages have not been examined in this species, but I assume they are generic in condition.

The first pair of gnathopoda resembles the same organ in *Hymenodora duplex*, but the basecphysis is wanting, which I attribute to injury, inasmuch as the muscles that move it are present; the coxa supports a mastigobranchia of extreme tenuity, and attached to it is a small podobranchial plume.

The second pair of gnathopoda is broken off at the distal extremity of the ischium.

The first two pairs of pereiopoda are chelate. The first and a portion of the fifth are the only parts preserved in the solitary specimen.

The pleopoda are biramose, but those of the first pair have the inner branch developed into a large membranous petasma, of considerably tenuity, to the inner margin of which is attached a short stylamblys fringed with cincinnuli on the inner side. All the other pleopoda are subequally biramose, and carry a long and slender stylamblys tipped with cincinnuli, except the posterior pair, which is not perfect enough for description.

Hymenodora, G. O. Sars.

Hymenodora, G. O. Sars, Archiv Mathem. Nat. Christiania, vii. p. 345, 1877.
Meningodora, Sidney Smith, Bull. Mus. Comp. Zoöl., vol. x. p. 73, 1882.

Integument soft and membranous. Carapace dorsally elevated and anteriorly produced to an imperfectly formed rostrum that does not project beyond the distal extremity of the first joint of the first pair of antennæ, and is formed by the meeting of the frontal margin on each side with the dorsal carina in the median line, which is generally furnished with a few small spinules.

Pleon laterally compressed and more or less carinated posteriorly.

Ophthalmopoda short, the ophthalmus imperfectly developed, and carrying both an ocellus and a tubercle.

First pair of antennæ having the peduncle short, robust, terminating in two short and unequal flagella.

Second pair supporting a foliaceous scaphocerite and a long slender flagellum.

Mandible supporting a three-jointed synaphipod.

Second pair of gnathopoda pediform and carrying a long basecphysis.

First two pairs of pereiopoda slender, subequal, and chelate, and both supporting a basecphysis. Posterior three pairs simple and terminating in a sharp-pointed dactylos, of which the posterior is the shortest.

Pleopoda biramose, the first pair in the males having the inner branch developed in the form of a petasma, and the outer branch of the rhipidura being long, and the telson tapering.

The animal is soft, and the integument very thin; the carapace is dorsally subcarinate or compressed to an angle which increases anteriorly and projects above the metope to a point that never extends beyond the first joint of the first pair of antennæ; the dorsal crest is generally surmounted by a row of minute denticles. The frontal margin slopes from the apex of the rostrum continuously to the orbit, which is clearly defined at the outer canthus by being lobed rather than pointed. The first antennal tooth is absent or rudimentary; the second is not largely projecting but is supported by a continuous ridge more or less distinct from the hepatic region.

The pleon has the first somite rather shorter than the others and dorsally rounded, as is also the second, but the third, fourth, and fifth are carinated in the median line, the

carina being sometimes reduced to a narrow thread-like ridge, and each somite has a tendency to be developed into a more or less perfect tooth.

The telson is long, narrow, tapering, and has the sides depressed.

The ophthalmopoda are compressed more or less distinctly, and support an ophthalmus that varies somewhat in form and size in different species, and on the inner surface a distinct tubercle that is also variable in different species both in length and importance.

The first pair of antennæ has a short and stout peduncle; the first joint being excavate on the upper surface and furnished on the outer with a short pointed stylocerite; the second and third joints are cylindrical and terminally support two flagella, of which the outer is broad and compressed at the base, where it is thickly furnished with membranous cilia, whence it tapers to a fine point.

The pleopoda are short and two-branched, that of the first pair being developed in the form of a petasma; the posterior pair has the outer rami, which help to form the rhipidura, without a diæresis.

Unfortunately, all the specimens in the collection are more or less injured; this is the more to be regretted since the genus is one of interest, resembling in many of its characters the genus *Benthesicymus*, from which it is so widely separated in the form and character of its branchiæ.

The branchial arrangement is given in the following table :—

Pleurobranchiæ,	.	.	.	...	...	...	...	...	...	1
Arthrobranchiæ,	.	.	.	1	1	2	2	2	2	...
Podobranchiæ,	.	.	.	...	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	1	r	r	r	r	...	...
				h	i	k	l	m	n	o

This genus is undoubtedly the same as *Meningodora*, Sidney Smith, which that author distinguishes from *Hymenodora*, Sars, upon a character which at most can be only of specific value, namely, that the coxal plate of the second somite of the pleon is so broad as to overlap the anterior somite. Buchholz's figure of the species (*Pasiphaë glacialis*) that Sars has taken for the type of *Hymenodora* shows that it is not broader than the coxal plates of the other somites. Mr. Sidney Smith also states that *Meningodora* is laterally compressed, whereas *Hymenodora* is not, but this difference is one of degree only, since in all the genera of the group lateral compression is a common feature.

The ophthalmopoda vary somewhat in form in different species that in other respects nearly approach each other, even when they come from distant localities, but in their typical condition they are transversely compressed and furnished with a tubercle on the inner side, which appears to be the rudimentary representative of a larger and more important organ, such as is seen in the deep-sea genera *Benthesicymus* and *Gennadas*, belonging to the Dendrobranchiata; this tubercle is totally distinct from the ocellus

common to many genera, but absent in this one, and is more nearly associated with the ophthalmus.

The first pair of antennæ has a short and stout peduncle, the first joint being excavate on the upper surface and furnished on the outer with a short pointed stylocerite; the second and third joints are cylindrical and terminally support two flagella, one of which is slender and the other robust, to a greater degree apparently in both sexes than is common. The peduncle is short, and situated close beneath the ophthalmopoda, has the first joint excavate or hollowed for the greater freedom of its movement; on the outer side the stylocerite exists as a thickened mass, pointed somewhat obtusely at the extremity, the outer margin being a vertical wall.

The second pair of antennæ carries a scaphocerite that is broad, tapering, and membranous, of considerable tenuity, and strengthened on the outer side by a ridge that terminates in a small tooth near the distal extremity; the peduncle has two very thick joints beyond the articulation of the scaphocerite. The length of the flagellum is nearly equal to half that of the animal.

The mandibles approximate in form to those of *Notostomus* in having a large psalistoma with a serrate margin continuous with the molar process, which is small, and carries a three-jointed synaphipod, the terminal joint of which is spatuliform.

The other oral appendages also resemble those of *Notostomus*, differing from them, apparently, only to a slight degree.

The gnathopoda also to a considerable extent resemble those of *Notostomus*. The first pair is subpediform and seven-jointed; the propodos and dactylos are broad, flat, and reflexed; the basis carries a long ecphysis, and the coxa supports a mastigobranchial plate, near to which, but separated from it, is a small arthrobranchial plume.

The second pair is pediform and five-jointed, the ischium and meros, and the propodos and dactylos being probably united; the ischio-meral joint is longitudinally triangulate and curved to afford room for the oral organs; the basis probably carries a rudimentary mastigobranchia, an arthrobranchial plume and an ecphysis, although I have not been able to determine it in the partially damaged specimen.

The first two pairs of pereiopoda are slender and chelate, the propodos not being enlarged; they are similar in form and subequal in size, the anterior being somewhat the smaller, and have the meros compressed, and each is furnished with a basecphysis, a rudimentary mastigobranchia, and two arthrobranchial plumes. The three succeeding pairs have the meros long and transversely flattened, the carpos short and the meros long and cylindrical, and the dactylos long and styliform except in the posterior pair, which is short and has the propodos furnished posteriorly with short stiff spinules; all carry a long basecphysis.

The first pair of pleopoda has the inner ramus membranous, and almost rudimentary in some species, whereas in others, as in *Hymenodora glauca*, it is larger and leaf-like,

and carries the stylamblys in a modified form, so that the appendage is suggestive of the petasma as it exists in *Penæus*.

The telson is long, narrow and tapering, and subequal with the lateral plates of the rhipidura.

Observations.—Mr. Sidney Smith suggests a close affinity of this species with *Acanthephyra*, which is true so far as the resemblance of the oral appendages, and the approximation between the genera is most apparent in *Hymenodora rostrata*, where the rostrum is longer and more distinctly dentated than usual. But with these parts the resemblance seems to cease. In *Acanthephyra* the rostrum is long and dentate above and below; the eyes are furnished with an ocellus and a rudimentary tubercle on the inner side; the scaphocerite is rigid, sharply pointed, and capable of being locked in a definite position and used as a weapon of offence; the propodos in the three posterior pairs of pereiopoda are not remarkably long as compared with the carpos, and the meros is not transversely compressed.

Geographical Distribution.—The species of this genus, like most of the family, are from deep water; only two specimens of one species being taken at a less depth than two miles.

They are mostly found in mid ocean, on a bottom of mud or ooze: in the Atlantic beneath the equator and as far south as the Island of Tristan da Cunha, and in the Indian Ocean as far south as Kerguelen Island. Buchholz's specimen[1] *Hymenodora* (*Pasiphaë*) *glacialis* was taken at the surface near the pack-ice in lat. 78° N., and *Hymenodora* (*Meningodora*) *mollis*, Sidney Smith, was taken off the eastern coast of the United States, whereas our specimen of the same species was taken off the eastern coast of South America, near Pernambuco. *Hymenodora duplex* was taken in the South Indian Ocean, and *Hymenodora rostrata* at the east entrance of Torres Strait, associated with *Tropiocaris tenuipes*.

In these localities the specimens which were taken are not numerous, and the depth was very considerable and varied from one and a half to two and a half miles. In the most typical forms the eyes have almost entirely lost their pigment; in some species it is reduced to a brown colour and in a few it is black, as if the degree of pigmentation was dependent upon variation in depth and degree of light.

Hymenodora mollis, Sidney Smith (Pl. CXXXVI. fig. 5).

Meningodora mollis, Sidney Smith, Bull. Mus. Comp. Zoöl., vol. x. p. 74, pl. xi. figs. 8–9; pl. xii. figs. 5–9.

Carapace slightly compressed anteriorly, and produced to a rostrum that is shorter than the first joint of the first antenna, and armed on the upper surface with eleven or twelve small teeth.

[1] Die zweite deutsche Nordpolarfahrt., Bd. ii., Crust., p. 279, 1874.

Pleon only slightly carinated, and dorsally produced to a small tooth on the third, fourth, and fifth somites.

Ophthalmopoda longer than the rostrum; ophthalmus small and round.

First and second pairs of pereiopoda chelate, the second longer than the first. Three following pairs of pereiopoda having meros and ischium laterally compressed, the propodos long and cylindrical, and the dactylos styliform. Posterior pair resembling the preceding excepting that the dactylos is short and almost lost amidst a brush of hairs.

Length, entire (female),	. . . . .	68 mm. (2·6 in.).
„ of carapace,	. . . . .	28 „
„ of pleon,	. . . . .	40 „
„ of third somite of pleon,	. . . .	9 „
„ of sixth somite of pleon,	. . . .	9 „
„ of telson,	. . . . .	12 „

Habitat.—Station 120, December 9, 1873; lat. 8° 37′ S., long. 34° 28′ W.; off Pernambuco; depth, 675 fathoms; bottom, red mud. One sepcimen, female. Trawled.

The carapace is slightly compressed on the frontal crest, and anteriorly produced to a rostrum that does not reach more than halfway to the extremity of the first joint of the peduncle of the first pair of antennæ, and has the crest armed with ten or twelve small teeth. The frontal margin supports a small tooth corresponding with the first pair of antennæ, and, further down, a second that corresponds with the second pair of antennæ; the latter is not large, but is strong and clearly defined, whence the frontal margin recedes and unites with the lateral margin without forming an angle. Posterior to the outer canthus of the orbit a slender, but stiff, ridge proceeds obliquely backwards and then divides, one branch passing along the upper margin of the branchial region, and the other and shorter branch descending to the hepatic region, where it is met by another rigid elevation that proceeds from the second antennal tooth.

The pleon is dorsally carinated, and posteriorly produced to a tooth on the third, fourth, and fifth somites.

The telson is considerably longer than the sixth somite, dorsally grooved, and has the lateral margins depressed.

The ophthalmopoda are longer than the rostrum, transversely compressed, and distally carry a small circular ophthalmus and support a small tubercle on the inner side.

The first pair of antennæ has the first joint depressed on the upper surface and carries a scaphocerite that suddenly terminates in a sharp point; the second and third joints are short, cylindrical, and terminally support two flagella, of which the outer is robust and the inner slender, both probably being a little shorter than the carapace.

The second pair of antennæ carries a broad scaphocerite of great tenuity, the outer

margin being strengthened by a narrow ridge which terminates in a small but sharp tooth somewhat short of the distal extremity of the squamous portion; the peduncle has two joints beyond the articulation of the scaphocerite, of which the distal is the longer; the flagellum is lost.

The second pair of gnathopoda is long and robust; the ultimate joint is broken, and the penultimate is narrower than the antepenultimate, which is long, reaching as far as the distal extremity of the peduncle of the first pair of antennæ, and has the inner surface for two-thirds of its length deeply excavate to leave room for the external oral appendages; the basis carries a long ecphysis that reaches nearly to the distal extremity of the meros.

The first pair of pereiopoda is chelate but not more robust than the second pair of gnathopoda. The second pair has the carpos and propodos longer than in the first pair. The three succeeding pairs have the ischium and meros long, broad and flattened, the carpos subcylindrical, the propodos long, and the dactylos long and styliform in the anterior two pairs and short in the posterior.

The pleopoda are biramose, the branches being flat and multiarticulate. In the first pair the inner branch is reduced to a rudimentary condition and fringed with long hairs. The posterior pair helps to form the rhipidura, and is imperfect in our only specimen.

Observations.—This species is almost quite smooth dorsally, having only a small narrow carina on the pleon and on the anterior portion of the carapace, the crest being reduced to a minimum ridge. The teeth on the third, fourth, and fifth somites are reduced to small points, but that on the third somite requires attentive observation to detect, although, when present, it is generally the most conspicuous.[1] This species is the same as that named *Meningodora mollis* by Sidney Smith, from which it appears to differ only in having more numerous denticles on the frontal crest, and in the ophthalmopoda reaching beyond the extremity of the rostrum instead of being shorter as in Smith's figure and description, but the variation is so slight that it must be considered as being specifically the same.

The specimen is laden with a number of small round ova, all of which are attached to the hairs that fringe the peduncles of the pleopoda.

Hymenodora duplex, n. sp. (Pl. CXXXVI. fig. 3).

Carapace anteriorly compressed to a rostral crest, that is not elevated above the line of the dorsum, or produced beyond the level of the ophthalmopoda, and armed with seven or eight small anteriorly directed denticles. Outer canthus of the orbit well defined; the first antennal tooth reduced to a minimum condition consistent with being called a tooth; second antennal tooth not large but clearly defined, projecting obliquely

[1] The dorsal teeth are too conspicuously represented on the plate.

outwards and forwards. Posterior portion of branchial wall of carapace more compressed than anterior portion and projecting over the coxal region of the first somite of the pleon, but underlying that of the second.

Pleon laterally compressed and dorsally carinated from the anterior margin of the second somite to the posterior margin of the fifth; carina on second somite obscure, on the third gradually increasing from the anterior margin and produced posteriorly in the form of a large laterally compressed tooth that is nearly as long as the two following somites; fourth somite dorsally carinated and terminating in a short tooth; fifth somite also carinated but less conspicuously, and terminating posteriorly in a minute tooth; sixth somite not carinated, but furnished with a minute tooth at the posterior extremity in the median line.

The telson is broken in our only specimen, but from the portion preserved it appears to be dorsally flattened, laterally compressed, long, narrow, and tapering.

Ophthalmopoda horizontally compressed and furnished with a small tubercle on the inner surface; ophthalmus larger than the stalk on which it stands.

First pair of antennæ having the first joint deeply excavate, laterally extended, and furnished with a short, obtusely pointed stylocerite; second and third joints cylindrical, and terminally carrying two flagella.

Second pair of antennæ having two joints to the peduncle beyond the attachment of the scaphocerite, which is broad and foliaceous; the flagellum is broken off.

Gnathopoda apparently of generic value only; the second pair is broken off.

First two pairs of pereiopoda slender and chelate, the second pair being longer and rather more slender than the first. Three succeeding pairs long and slender; the basis carrying an ecphysis; ischium and meros transversely compressed; propodos very long, cylindrical, and supporting a styliform dactylos that is long in the anterior two pairs and short in the posterior.

Pleopoda biramose.

The rhipidura is injured, so that the length of the several parts cannot with certainty be determined.

Length, entire,	. . . . .	73 mm. (3 in.).
„	of carapace, ...	27 „
„	of pleon, ...	46 „
„	of third somite of pleon, ...	21 „
„	of sixth somite of pleon, ...	10 „
„	of telson, ...	13 „

Habitat.—Station 147, December 30, 1873; lat. 46° 16′ S., long. 48° 27′ E.; off Marion Island; depth, 1600 fathoms; bottom, Diatom ooze; bottom temperature, 34°·2. One specimen, female. Trawled.

This species is remarkable for the exceptional development of the tooth-like structure on the posterior margin of the third somite of the pleon, which is developed in a carina-like form and overhangs the two succeeding somites, while that on the fourth is shorter and almost covered by it, giving the appearance of two projections from one somite. It is not only the carina that projects but the dorsal surface of the somite is suddenly produced on each side, halfway between the median line and the angle formed by the coxal scale, at a right angle to the lateral margin, above which lies the laterally narrow carina that increases in height as it projects posteriorly, whereas on each of the somites anteriorly and posteriorly the carina is reduced in character, dying out on the first and last somites, the terminal tooth of the somites gradually getting reduced in size posteriorly.

The ophthalmopoda are moderately long, slightly compressed transversely, and furnished on the inner side with a small tubercle near the ophthalmus, which is hemispherical; it is lodged in a small notch-like orbit that is clearly defined by a rounded outer canthus.

The first pair of antennæ has the peduncle very robust and short; the first joint extends beyond the extremity of the rostrum, and is deeply excavate for the reception of the ophthalmopod; on the outer side there is a short stout stylocerite, the external surface of which is vertical or nearly so, and terminates in a small sharp tooth that reaches to about half the length of the joint. The cilia that form the blepharis so common in most species is altogether absent, and this is apparently not the result of accident, but indicates the permanent condition.

The second and third joints are very short, cylindrical, and together are about half the length of the first, and are very thick, the second more so than the third. The flagella are very unequal, the upper and outer being much more stout than the inner and lower; the lower surface of the upper is flattened and occupied by a series of membranous cilia. The lower flagellum is slender almost to the base, which is slightly enlarged and conformable with the under surface of the upper; both are obscurely multiarticulate and free from hairs; the length cannot be determined in this specimen, as the organs are broken off short.

The second pair of antennæ has the peduncle very stout and carries an apparently large scaphocerite, the length of which cannot be determined, but it appears to be more rigid than the other organ, for which purpose it is strengthened by two long, narrow, rod-like ridges, one on the outer margin within and parallel with it; beyond the articulation of the scaphocerite there are two well-developed and robust joints, of which the distal is the longer and stouter. The flagellum is wanting.

The mandibles and the oral appendages correspond closely with those of *Notostomus*, scarcely exhibiting even a specific variation.

The first pair of gnathopoda is seven-jointed and subpediform, and resembles that of

Notostomus, excepting in the relative lengths of the several joints and in having the mastigobranchial plates larger in proportion.

The second pair of gnathopoda is broken off near the mero-carpal articulation, but the joints remaining are compressed and curved.

The pereiopoda so far as preserved resemble those of *Hymenodora mollis*, and are remarkable for the great length of the propodos, which is cylindrical, and for the flattened or compressed condition of the ischium and meros. The first two pairs are chelate and slender, the second being more slender than the first and having the carpos longer than the propodos, and all are furnished with a well-developed basecphysis.

The first pair of pleopoda has the inner ramus reduced to a rudimentary condition; all the others have the two branches subequal, the inner of the anterior pair carrying a long, slender, and cylindrical stylamblys, the extremity of which is furnished with a bundle of small cincinnuli. The posterior pair is too much damaged to be described, but what remains appears to be of generic character.

Hymenodora rostrata, n. sp. (Pl. CXXXVI. fig. 4).

Dorsal surface of the carapace laterally compressed and anteriorly produced in a depressed line to a sharply pointed rostrum, that reaches as far as the distal extremity of the first joint of the first pair of antennæ, and furnished on the upper surface with eight small denticles; inferior margin smooth and receding obliquely to the orbit, which is clearly defined but furnished with no tooth at the outer canthus. First and second antennal teeth small; the second is strengthened by a long carina-like ridge that proceeds posteriorly from it.

Pleon slightly carinated and produced to a small tooth on the fourth and fifth somites; on the third and sixth the carina terminates abruptly.

Length, entire,	. . . . .	40	mm. (1·5 in.).
„	of carapace, ...	15	„
„	of rostrum, ...	3	„
„	of pleon, ...	25	„
„	of third somite of pleon, ...	5	„
„	of sixth somite of pleon, ...	65	„
„	of telson, ...	9	„

Habitat.—Station 184, August 29, 1874; lat. 12° 8′ S., long. 145° 10′ E.; near Torres Strait; depth, 1400 fathoms; bottom, Globigerina ooze; bottom temperature, 36°. One specimen, male. Trawled.

Station 205, November 13, 1874; lat. 16° 42′ N.; long. 119° 22′ S.; Philippine Islands; depth, 1050 fathoms; bottom, blue mud; bottom temperature, 37°. One specimen, male. Trawled.

Station 245, June 30, 1875; lat. 36° 23′ N., long. 174° 31′ E.; North Pacific; depth, 2775 fathoms. Taken in a tow-net sent down to over 1700 fathoms.

This species shows the development of the rostrum more after the manner of the normal Phyllobranchiata than do the other described species, and exhibits the direction in which generic relationship exists. This species differs little in structural character from *Acanthephyra*, except in the soft and membranous condition of the dermal tissues, the shortness of the rostrum, which in this genus never reaches beyond the first joint of the first pair of antennæ, the absence of the ocellus, and the length of the propodos of the posterior pair of pereiopoda.

The ophthalmopoda in this species are short and broad, being nearly as broad as long, scarcely compressed, and the ophthalmus is brown in colour.

The first pair of antennæ has the first joint of the peduncle deeply excavate, more so than is usual in this genus; the distal outer angle is produced to a process, and the stylocerite is stout, sharply pointed, and about half the length of the joint.

Most of the appendages are broken off and lost, but the chelate pereiopoda and the posterior pair are present and exhibit the features common to the genus.

The first pair of pleopoda has the inner ramus developed as a small foliaceous plate, and the others carry a long and slender stylamblys.

Hymenodora glauca, n. sp. (Pl. CXXXVII. fig. 1).

Dermal structure soft, flexible and smooth, carapace slightly compressed over the frontal region to a median ridge, which is furnished with three or four minute denticles; anteriorly the carapace projects as far as the extremities of the ophthalmopoda in a rounded margin, the central point of which is furnished with a small sharp denticle, beneath which is a second of nearly equal importance.

The pleon is smooth and laterally compressed, the sixth somite being about twice the length of the preceding and subequal with the telson, which is long, narrow and tapering, having the lateral margins depressed, and the dorsal surface flattened.

The ophthalmopoda are short, horizontally flattened, broader at the base than at the distal extremity, near which on the inner side, in close proximity to the ophthalmus, is a small but conspicuous tubercle.

The first pair of antennæ has the peduncle about one-third the length of the carapace; it is stout and has the first joint slightly depressed to receive the ophthalmopoda, and the stylocerite exists as a bluntly pointed vertical wall on the outer side; the second and third joints are short and cylindrical, and support two flagella, of which the outer is the more robust and is enlarged at the base, on the under surface of which is a thick brush of membranous cilia, the inner flagellum is slender and filiform throughout, and both are subequal with the length of the carapace.

The first pair of gnathopoda is subpediform and seven-jointed; the coxal joint supports a mastigobranchia and an arthrobranchial plume, and the basis an ecphysis; the two terminal joints are reflexed against the preceding.

The second pair of gnathopoda is pediform and five-jointed, the last two joints articulating with the preceding at the inferior angle of the distal extremity; the coxa carries a small mastigobranchia and an arthrobranchial plume; the basis supports a slender and moderately long ecphysis; the next two joints coalesce and are long and curved, and the terminal two are straight and fringed with long hairs.

The first two pairs of pereiopoda are slender, short, and subequally chelate; the next three pairs are slender and simple.

The pleopoda are biramose, the first pair having the inner branch in the form of a petasma.

The telson is damaged in the typical specimen, but appears to be long, slender, and tapering, having the sides depressed.

Length, entire,	55 mm. (2·1 in.).
,, of carapace,	20 ,,
,, of rostrum,	2 ,,
,, of pleon,	35 ,,
,, of third somite of pleon,	6 ,,
,, of sixth somite of pleon,	8 ,,
,, of telson,	? ,,

Habitat.—Station 159, March 10, 1874; lat. 47° 25′ S., long. 130° 22′ E.; south of Australia; depth, 2150 fathoms; bottom, Globigerina ooze; bottom temperature, 34°·5. One specimen, male. Trawled.

Station 215, February 12, 1875; lat. 4° 19′ N., long. 130° 15′ E.; south of the Philippines; depth, 2550 fathoms; bottom, red clay; bottom temperature, 35°·4. One specimen, damaged. Trawled.

Hymenodora mollicutis, n. sp. (Pl. CXXXVII. fig. 2).

Carapace smooth and slightly compressed anteriorly, a small carina traverses the frontal region in the median line, and projects anteriorly as a rostrum in the form of a small tooth. The dorsal surface of the pleon is smooth, without any sign of a carina or dental projection.

The ophthalmopoda are stout and flat and carry the tubercular protuberance distally on the inner side, near the ophthalmus, which is of a fawn or pale yellow colour.

The first pair of antennæ has the peduncle stout, and deeply excavate at the base, and terminates in two flagella, of which the upper is much stouter than the lower.

The second pair of gnathopoda is robust and styliform.

The two anterior pairs of pereiopoda are chelate and subequal. The two following have the meros subcylindrical and terminate in a styliform dactylos, that of the posterior pair being short and stunted.

	Female.	Male.
Length, entire, ...	50 mm. (2 in.).	60 mm. (2·3 in.).
„ of carapace, . . .	19 „	21 „
„ of rostrum, . . .	5 „	5 „
„ of pleon, ...	31 „	39 „
„ of third somite of pleon, .	5 „	7 „
„ of sixth somite of pleon, .	8 „	9 „
„ of telson, . . .	(?) „	12 „

Habitat.—Station 104, March 23, 1873; lat. 2° 25′ N., long. 20° 1′ W.; Atlantic; depth, 2500 fathoms; bottom, Globigerina ooze; bottom temperature, 36°·6. One specimen, female with ova. Trawled. Length, 50 mm.

Station 87, July 21, 1873; lat. 25° 49′ N., long. 20° 55′ W.; near the Canary Islands; depth, 1675 fathoms; bottom, rock. One specimen, male. Dredged. Length, 62 mm.

Station 133, October 11, 1873; lat. 35° 41′ S., long. 20° 55′ W.; near Tristan da Cunha; depth, 1900 fathoms; bottom, Globigerina ooze; bottom temperature, 35°·4. Two specimens; one male (damaged), one female. Trawled.

Station 156, February 26, 1874; lat. 62° 26′ S., long. 95° 44′ S.; depth, 1975 fathoms; bottom, Diatom ooze. One specimen, male. Trawled. Length, 25 mm.

Station 157, March 3, 1874; lat. 53° 55′ S., long. 108° 35′ S.; depth, 1950 fathoms; bottom, Diatom ooze; bottom temperature, 32°·1. Two specimens, males. Trawled. Length, 70 mm.

Station 318, February 11, 1876; lat. 42° 32′ S., long. 56° 29′ W.; depth, 2040 fathoms; bottom, blue mud; bottom temperature, 33°·7. One specimen, female. Trawled. Length, 50 mm.

The carapace is slightly depressed between the gastric and cardiac regions, slightly arcuate over the gastric region, and in the median line compressed to a ridge that is adorned with four small denticles, posterior to the rostral point, which does not reach as far as the distal extremity of the ophthalmopoda; from the extremity at the base of the small rostral projection, the frontal surface abruptly descends and unites with the metope, and does not carry a small tooth as in *Hymenodora glauca*, being smooth throughout.

This species differs from *Hymenodora glauca* most conspicuously by having no denticle on the metope beneath the rostral tooth, and by the last two joints of the second pair of gnathopoda articulating with the preceding joint at the extremity, instead of on the under surface.

Observations.—It appears to be very commonly distributed, since it has been taken

in the Atlantic and South Indian Oceans at an approximate depth of about 2000 fathoms.

The specimen taken at Station 104 carried from thirty to forty eggs of an ovate form and large size, in which the embryo is present, sufficiently advanced to demonstrate the character of the brephalos to be that of the *Megalopa* stage.

The specimen from Station 87 has the dorsal crest almost smooth, the small denticles being either in a rudimentary condition or broken off by friction. In this specimen the outer plates of the rhipidura are preserved, and close inspection, even after the application of a reagent, failed to show the presence of a diæresis, and the small tooth on the outer margin that demonstrates its position when present is wanting, although a small notch shows its position. This is also the condition in the two specimens taken at Station 157. In one of these the animal was not far from the point of moulting. The form of the plate is rounded at the extremity, and almost smooth, or where more highly magnified shows small indentations from which hairs have been removed, and a small denticle is present at the outer angle. Within the cuticle the new dermal structure is in an advanced condition, and exhibits the presence of long slender hairs along the distal margin, and the outer angle bears, not a minute denticle, but a long hair and a strong spine, beyond which the outer margin is smooth, although in some specimens a series of small dots are regularly placed, suggesting the presence of a number of minute hairs on the under side within the margin.

In one of the two specimens from Station 133 the telson is tolerably preserved, which is not the case in the type specimen. It is longer than the lateral plates of the rhipidura, and nearly twice the length of the sixth somite, and probably terminates in a few hairs of greater or less length, but which are broken off.

Family Stylodactylidæ.

This family is established to receive those forms, of which only one genus is known, in which the first pair of gnathopoda terminates in two branches, subequal in size and importance, and the propodos of the two chelate pereiopoda has the palm short and the pollex and dactylos long, slender, and feeble.

Stylodactylus, A. Milne-Edwards.

Stylodactylus, A. Milne-Edwards, Ann. d. Sci. Nat., sér. 6, tom. xi. p. 11, 1884; Recueil de Fig. Crust. nouv., 1883.

Carapace one-third of the length of the body, dorsally rounded, anteriorly compressed to a slight carina, and produced to a long, slender, and laterally compressed rostrum,

armed on the upper and lower margins with long stout articulated spines. Frontal margin having the orbit defined by an inner and an outer canthus. First and second antennal teeth strong and well developed. Fronto-lateral angle rounded.

Pleon dorsally smooth and round; sixth somite scarcely longer than the fifth.

Telson longer than the sixth somite, dorsally flattened, and laterally armed with minute spinules; posterior extremity produced to a sharp point furnished on each side with movable spines or hairs.

Ophthalmopoda pyriform, uniarticulate, and near together.

First pair of antennæ having a strong stylocerite, and terminating in two long and slender flagella.

Second pair of antennæ furnished with a pointed scaphocerite aud carrying a long and robust flagellum.

First pair of gnathopoda terminating in a duplex joint.

Second pair of gnathopoda six-jointed, long, slender, and pediform.

First two pairs of pereiopoda long, slender, and chelate; the carpos long, the palm of the propodos short, and the pollex and dactylos long, slender, and styliform. Posterior three pairs robust, having a sharp carpos, a long propodos, and a short dactylos.

Pleopoda biramose, the first pair having the inner branch short and the posterior pair broad and subequal in length with the telson.

Geographical Distribution.—The first specimens were taken on the 15th of July 1874, near the Kermadec Islands in the Pacific, another was taken near the Admiralty Islands, and the third, being the type on which A. Milne-Edwards founded the genus, was taken by Professor Agassiz off St. Domingo. The average range of depth is between 400 and 500 fathoms.

Stylodactylus discissipes, n. sp. (Pl. CXXXVIII. fig. 1).

Carapace quite one-third of the length of the animal; posterior dorsal surface smooth and round; frontal region compressed to a carina that is not elevated above the carapace, and produced anteriorly to a laterally compressed rostrum that is slightly elevated at the extremity, and armed on the upper surface with thirty strong and robust spines that articulate with the rostrum, the posterior standing on the gastric region, and the anterior near the apex. First and second antennal teeth well developed.

Pleon having the third somite not arcuate and not longer than the preceding; sixth somite subequal with the fifth.

Telson shorter than the two preceding somites, and corresponding in length with the inner plates of the rhipidura, dorsally flattened, and armed at the dorso-lateral angles with five spinules, and terminating in a short central point and seven spines.

Ophthalmopoda short and pyriform; ophthalmus brown in colour.

First pair of antennæ having the flagella slender, the outer branch a little more robust than the inner, and both about half as long again as the rostrum; the first joint of the peduncle carries a sharp stylocerite that reaches as far as the second joint.

Second pair of antennæ carrying a scaphocerite that reaches a little beyond the peduncle of the first pair and terminates in a sharp point; the flagellum is longer than the animal.

First pair of gnathopoda subpediform and terminationg in two branches implanted side by side on the extremity of the preceding joint.

Second pair of gnathopoda pediform, long and slender, having the penultimate joint armed with fine stiff spines on the anterior and outer margins, as also on the preceding joint.

First two pairs of pereiopoda similar in form and terminating in two long and slender fingers, equal in size and similar in form, and fringed with ciliated hairs; the carpos carries a few long spines on the anterior margin and hairs on the posterior. Posterior three pairs fringed with strong teeth on the posterior margin, and terminating in a short, sharp, curved, smooth dactylos.

Rhipidura broadly expanded; peduncle armed with a strong tooth; outer plate having a diæresis defined by a strong tooth and long spine.

Length, entire,	28	mm. (1·1 in.).
„ of carapace,	8	„
„ of rostrum,	10	„
„ of pleon,	20	„
„ of third somite of pleon,	3	„
„ of sixth somite of pleon,	3·5	„
„ of telson,	4	„

Habitat.—Station 171, July 15, 1874; lat. 28° 33′ S., long. 177° 50′ W.; north of the Kermadec Islands; depth, 600 fathoms; bottom, hard ground; bottom temperature, 39°·5. Two specimens; one male, one female (?). Trawled. Associated with *Stylodactylus orientalis*, *Benthesicymus*, and *Hemipenæus*.

The two specimens correspond so closely in general form and in most of the details, that it is difficult to believe that they are not one and the same species, but the differences between them are the same in kind as those which distinguish them from the specimen obtained by Agassiz in the West Indies, namely, the relative length of the rostrum and the general armature of the animal.

In the specimen from which our figure and description are taken, the rostrum is longer than the carapace in the proportion of 10 mm. to 8 mm., measuring from the orbit, and the number of spinules on the upper margin is twenty-seven, and on the lower fourteen. In the larger specimen taken at the same station the relative lengths are

13 and 12 mm., while the spinules on the upper margin of the rostrum are thirty, and on the lower fifteen. In *Stylodactylus serratus* A. Milne-Edwards says that there are forty spines on the upper margin, and more than twenty on the lower, and that the proportion of the rostrum to the carapace is 24 mm. to 20 mm.; but *Stylodactylus serratus* is nearly double the size of any of the Oriental specimens. The comparative lengths of the three specimens are as follows :—

	Rostrum.	Carapace.	Entire length.	Rostral spines.
Stylodactylus serratus, A. M.-E.,	24 mm.	20 mm.	65 mm.	$\left\{\frac{40}{20}\right.$
Stylodactylus discissipes, . .	10 „	8 „	28 „	$\left\{\frac{27}{14}\right.$
Stylodactylus orientalis, . .	13 „	13 „	38 „	$\left\{\frac{30}{15}\right.$

The length of the carapace to that of the entire animal is relatively the same in each, being little less than one-third of the animal, measuring from the orbital margin to the extremity of the telson. The rostrum varies in relative length, and the armature varies still more, especially as exhibited on the upper margin. All the spines articulate with the base on which they stand.

In *Stylodactylus discissipes* the dorsal crest is slightly elevated, and a depression exists on the dorsum corresponding with the cervical fossa, anterior to which the rostral carina ends. The pleon is dorsally rounded, and all the somites are subequal in length, the second being rather the longest.

The first pair of antennæ has the flagella unequal, the inner pair reaching but little beyond the extremity of the rostrum.

The second pair of antennæ has the scaphocerite sharply pointed at the outer distal extremity, and reaches a little beyond the peduncle of the first pair. A long and conspicuous tooth stands on the outer and distal angle of the second joint of the peduncle at the base of the scaphocerite. The ultimate joint is very stout, and supports a flagellum that is a little longer than the animal, and tolerably strong and not readily detached.

The oral appendages have not been examined in this the most perfect specimen ; they are described in *Stylodactylus orientalis.*

The first pair of gnathopoda are, so far as my experience goes, unique in structure ; they are subpediform ; the basis carries a long, slender, and rather stiff ecphysis, the two succeeding joints are long and robust, and support at the extremity two broad, flat, spatuliform plates that articulate side by side ; they are blunt or rounded at the extremity, and fringed with long hairs.

The second pair of gnathopoda is pediform, and has six joints ; the meros and carpos are very long, and armed with short spinules and long hairs, the dactylos being either wanting or fused with the propodos.

The first two pairs of pereiopoda are nominally chelate, the meros and carpos being long and fringed with short spines on the anterior margin, and hairs on the posterior. The carpos is long and slender, the propodos has an extremely short palm, and supports a long and feeble pollex, and articulates with a dactylos which lies parallel with it and corresponds in its entire length. They are fringed with ciliated hairs posteriorly, and are smooth anteriorly. The posterior three pairs are robust and not long; the meros is sparsely armed with spines on the anterior surface, of which the last is produced from the distal or carpal angle, and posteriorly with strong teeth that increase in length towards the carpal joint. The carpos is armed with spines on the posterior margin, but is smooth on the anterior, the distal extremity of which overlaps the carpal extremity of the propodos, which is about three times as long as the carpos; it is smooth on the anterior margin, and fringed with spines on the posterior. At the carpal extremity of the anterior surface is a depression into which the distal process of the carpos falls, and supports the leg in its extended direction; the dactylos is short, curved, and sharply pointed.

The pleopoda are all equally biramose, excepting the first pair, and that has the inner branch reduced to a small membranous plate. The posterior pair is articulated laterally, and carries a large tooth at the outer angle of the basal joint. The inner branch is about the same length as the telson, lanceolate in form, and fringed on both sides with hairs, the outer branch is not longer than the inner, it is very broad, and is furnished with a diæresis that is armed on the outer extremity with a short tooth and a strong spine.

Stylodactylus orientalis, n. sp. (Pl. CXXXVIII. fig. 2).

Rostrum as long as the carapace, armed on the upper surface with thirty spines, and on the lower with fifteen. Inferior margin of the carapace strengthened by a calcified ridge.

The general armature of the specimen is stronger, and the dermal tissue more rigid than in *Stylodactylus discissipes*, but with this exception and the proportional length of the rostrum, the closest inspection does not enable me to distinguish any character of specific value.

Length, entire,	38	mm. (1·5 in.).
„ of carapace,	11	„
„ of rostrum,	14	„
„ of pleon,	27	„
„ of third somite of pleon,	4	„
„ of sixth somite of pleon,	4·5	„
„ of telson,	5·5	„

Habitat.—Station 171, July 15, 1874; lat. 28° 33′ S., long. 177° 50′ W., north of the Kermadec Islands; depth, 600 fathoms; bottom, hard ground; bottom temperature, 39°·5. One specimen, female. Trawled.

The description given of the preceding species agrees with the present form, except that the general structure is stronger and more pronounced in this specimen, which would have been selected as the type had not certain important parts, more especially the peculiar chelate appendages, been wanting.

In this species I had the opportunity of examining the oral appendages, which I was not able to do in *Stylodactylus discissipes*.

The mandibles (fig. 2*d*) have a broad psalistoma connected with the molar prominence, furnished with a few strong dental processes, and carry a biarticulate synaphipod fringed with hairs, of which the longest are attached to the first joint.

The first pair of siagnopoda (fig. 2*e*) consists of three short branches; the inner is short, flat, curved, and distally fringed with a few hairs; the second or median is bat-shaped, being narrow at the base, and distally broad, flat, the distal margin being rounded and fringed with small cilia; the outer branch is short, cylindrical, and bifid at the extremity.

The second pair of siagnopoda (fig. 2*f*) consists of a cylindrical and two broad but small plates on the inner side, the margins of which are fringed with hairs; the first has the margins parallel, the second is bat-shaped, and the third is short, cylindrical, and tipped with hairs; on the outer side is a large, broad, flat, squamous plate, fringed with hairs, of which those on the posterior extremity are sufficiently long to reach to the posterior extremity of the branchial chamber.

The third pair of siagnopoda (fig. 2*g*) consists of one large and one small squamous plate, beyond which, fringed with hairs, is a narrow subcylindrical median plate tipped with hairs, and on the outer side a broad squamous plate of great tenuity, from the inner margin of which arises a slender cylindrical branch that tapers to the extremity and is tipped with hairs; at the base of the plate stands two membranous plates.

The second pair of gnathopoda, as well as all the pereiopoda except the last pair, carry attached to the coxa a short, broad, flat, mobile plate, fringed on the upper surface with hairs, which is the rudiment of the mastigobranchial appendage.

All the other parts bear a close resemblance to those described in other species, and from which I am not able to determine any specific distinction besides those mentioned.

Observations.—This species was found associated with *Stylodactylus discissipes*, from which it differs chiefly in the length of the rostrum and the number of teeth that ornament it, as also from *Stylodactylus serratus* of the West Indies, from which it may also be determined by the presence of small spines on the anterior margins of the carpal joints of the second pair of gnathopoda and the first two pairs of pereiopoda.

Stylodactylus bimaxillaris, n. sp. (Pl. CXXXVIII. fig. 3).

Carapace less than one-third of the length of the animal; rostrum about once and a half the length of the carapace, and armed on the upper margin with thirty-six fine

spines, commencing over the gastric region and on the lower margin with seven or eight long ones. Antennal teeth on the frontal margin small.

Pleon dorsally smooth; third somite considerably longer than the others, and dorsally arcuate, slightly compressed, and posteriorly projecting in the median line; sixth somite slightly longer than the fifth.

Telson as long as the two preceding somites, dorsally flattened, and having the dorso-lateral angles armed with several small spinules arranged in a longitudinal row.

Ophthalmopoda pyriform.

First pair of antennæ having the flagella short, scarcely reaching beyond the rostrum.

Second pair of antennæ having the scaphocerite long and slender, two-thirds the length of the rostrum.

Pereiopoda smooth and generally free from spines on the anterior margin, and posteriorly fringed with long hairs.

Length, entire, ...	26 mm. (1 in.).
„ of carapace, ...	8 „
„ of rostrum, ...	9 „
„ of pleon, ...	18 „
„ of third somite of pleon, ...	5 „
„ of sixth somite of pleon, ...	3 „
„ of telson, ...	5 „

Habitat.—Station 219, March 10, 1875; lat. 1° 54′ 0″ S., long. 146° 39′ 40″ E.; off the Admiralty Islands; depth, 150 fathoms; bottom, coral mud. One specimen, female, laden with ova. Trawled.

The specimen from which this description is taken is a distinct and fixed species, and may readily be distinguished from the others by the greater length and by the form of the third somite of the pleon, and by the general armature being less pronounced. In the other species the spines on the upper margin of the rostrum are larger than those on the lower, but in this species they are finer and less conspicuous, and more regularly placed than those on the lower, and the antennal teeth on the frontal margin are not so well developed.

The ophthalmopoda are less stout and carry a black ophthalmus that is furnished with a small circular ocellus.

The first pair of antennæ does not reach beyond the extremity of the rostrum, the outer flagellum being thick nearly to the apex, where it is suddenly reduced to a thread-like extremity of a diameter similar to that of the inner flagellum; the first joint is long and depressed on the upper surface, and carries a sharply pointed stylocerite that is about half the length of the joint.

The second pair of antennæ carries a very long scaphocerite that has the outer margin curved outwards, the apex sharply pointed and rigid, and the inner foliaceous division reduced to a longitudinal narrow margin, fringed with long hairs. The basal joint carries a small tooth on the upper surface near the articulation of the scaphocerite.

The oral appendages have not been examined in this specimen.

The first pair of gnathopoda lies curved up against the mouth, and is seven-jointed; the terminal joint is double, and the coxa carries a small branchial plume, but I have not detected a mastigobranchial plate; the basis carries a long and slender ecphysis; the ischium is long, subcylindrical, and fringed on the inner surface with numerous much ciliated strong stiff hairs; the next joint, which is analogous to the carpos, curves abruptly round, so that the more distal joints are flexed against the ischium; the next joint, which represents the propodos, is subcylindrical and increases in diameter distally, at which extremity the terminal branches stand side by side, one longer than the other, and both are flat, long-ovate, and copiously fringed with stiff, curved, and ciliated hairs; some longer hairs stand on the outer angle of the preceding joint and fringe the inner margin, all possessing stout and strong cilia, giving to the organ a powerful brush-like character, so that it has the power of sweeping an area round the mouth and collecting material for food.

The second pair of gnathopoda has been broken at the carpal-joint of the meros, but so far as preserved it generally resembles that of the preceding species.

The first two pairs of pereiopoda are free from teeth on the anterior margin and fringed with hairs on the posterior; the palm is very short, and the fingers long, straight, and parallel. The posterior three pairs are strong and smooth, being free from the dentation or the spinous condition of the preceding species.

The pleopoda are biramose; the first pair has the inner branch short and bud-like, and the others have the two branches subequal. The terminal pair helps to form the rhipidura, and is subequal in length with the telson; the outer branch is the longer, has an oblique diæresis, and is armed at the outer margin with a small tooth and spine.

Family Pasiphæidæ.

This family has not been well defined. Milne-Edwards[1] says that the genus *Pasiphæa* establishes in many respects a passage between *Penæus* and *Sergestes*, but this view, I think, cannot be accepted, seeing that *Pasiphæa* belongs to the Phyllobranchiata and *Penæus* and *Sergestes* belong to the Dendrobranchiata, the different form of the branchiæ in the two divisions precluding these genera from belonging to one and the same division.

The remarkable features in the Pasiphæidæ appear to exist in the imperfect develop-

[1] Hist. Nat. Crust., tom. ii. p. 424.

ment of some of the pereiopoda, while others are well formed; for instance in the genus *Pasiphæa* the first two pairs of pereiopoda are well developed, whereas the three posterior pairs are diminutive in size and imperfectly formed.

The genus *Leptochela* has also the first two pairs of pereiopoda well developed, while the three posterior pairs are slender and feeble. In *Pasiphæa* there is no synaphipod attached to the mandibles, and in *Leptochela* the same appendage is only single-jointed. In *Orphania* the chelate pereiopoda are well developed, and the three posterior slender and feeble.

These three genera I propose to unite in this one family, and there are probably others which may be found possessing features that may bring them within its range.

Leptochela, Stimpson.

Leptochela, Stimpson, Proc. Acad. Nat. Sci. Philad., p. 111, 1860.

Carapace smooth, scarcely crested; lateral walls and margin destitute of spines. Rostrum very short, spiniform.

First pair of antennæ biflagellate.

Mandibles inflexed, broad, and compressed; synaphipod short, ovate, and uniarticulate.

First pair of gnathopoda not pediform, having the last joint armed with long spines.

Second pair of gnathopoda furnished with an ecphysis.

Pereiopoda carrying a basecphysis. First and second pairs compressed, chelate, slender, with long parallel dactyli; three posterior pairs short.

Pleon having the antepenultimate somite more or less abruptly curved.

Pleopoda biramose, rhipidura well developed.

Telson long, narrow, and tapering.

The above definition corresponds closely with Dr. Stimpson's description of the genus, which he considers to bear a close affinity to *Pasiphæa*, differing only in having the mandibles with a synaphipod, and in the first pair of gnathopoda not being pediform.

The description coincides with the characters of the specimen in the Challenger collection, except that what Dr. Simpson calls "long spines" on the terminal joint of the first pair of gnathopoda I should have called hairs.

The arrangement of the branchiæ, as observed in *Leptochela robusta*, is shown in the following table:—

Pleurobranchiæ,	.	.	.	...	...	1	1	1	1	1
Arthrobranchiæ,	.	.	.	...	...	1	1	1	1	...
Podobranchiæ,	.	.	.	...	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	r	r	...	...	...	...	...
				h	i	k	l	m	n	o

Geographical Distribution.—Dr. Stimpson obtained some specimens of *Leptochela gracilis* from deep water in the Gulf of Kagosima, and *Leptochela robusta*, at a depth

of 20 fathoms, in the China Sea, and also near the Island of Loochoo. Of the Challenger specimens of this genus, *Leptochela serratorbita* was taken off St. Thomas Island, West Indies, and *Leptochela robusta* in Bass Strait, while *Leptochela gracilis* was captured near the southern coast of Japan.

Leptochela serratorbita, n. sp. (Pl. CXXXIX. fig. 1).

Orbital margin fringed with a series of small teeth. Dorsal surface of the fifth and sixth somites of the pleon smooth.

Second pair of gnathopoda furnished with a large and pointed tooth.

Length, entire,	13	mm. (0·5 in.).
,, of carapace,	3	,,
,, of rostrum,	0·7	,,
,, of pleon,	10	,,
,, of third somite of pleon,	2	,,
,, of sixth somite of pleon,	1·5	,,
,, of telson,	2·5	,,

Habitat.—St. Thomas, West Indies ; shallow water. One specimen, associated with *Platybema rugosum.*

The carapace is smooth and anteriorly produced to a sharp horizontal rostrum. The orbit extends to the first antennal tooth, and has the margin serrate ; the second antennal tooth is reduced to a point ; the lateral plates of the first somite of the pleon overlap the posterior margin of the carapace, and the dorsal surface of the posterior somites is unarmed and smooth.

The telson is as long as the lateral plates of the rhipidura.

The ophthalmopoda are shorter than the rostrum, robust, and have the ophthalmus orbicular, and but little larger in diameter than the stalk.

The first pair of antennæ is subequal and short.

The second pair of antennæ has the scaphocerite longer than the peduncle of the first pair, and the flagellum slender (broken).

The mandibles are broad, flat, and serrate at the margin, with sharply cut teeth that are largest towards the front, and furnished with a short ovate single-jointed synaphipod, tipped with six ciliated hairs.

The first pair of siagnopoda is three-branched ; the inner branch is small and the middle broad and foliaceous, both being tipped with hairs ; the third, which appears to represent the basecphysis, is narrow and two-jointed, the terminal joint being small and bud-like.

The second pair of siagnopoda consists of four plates ; two on the inner surface which

are foliaceous and tipped with a thick fringe of hairs, a third that is sharply pointed and single, and a fourth that is broad and foliaceous, extending forwards beyond the apex of the previous one and posteriorly into the branchial chamber, and has the margin furnished with radiating cilia.

The first pair of gnathopoda is short and subpediform, consisting of six joints, of which the terminal is small and tipped with five or six spine-like hairs, similar to others that fringe the outer margin of the second joint; it carries no branch attached to the basisal joint, and only the rudiment of a mastigobranchial plate.

The second pair of gnathopoda is long, slender, and pediform, and carries a long basecphysis and a rudimentary mastigobranchial plate.

The first pair of pereiopoda is slender and not very long, the chela is scarcely wider than the carpos, and the fingers are long, slender, and parallel, the inner margins being fringed with long and slender teeth, every third and fourth being longer than the others; the outer margin of the pollex is smooth, while that of the dactylos is armed with four or five equidistant solitary spines. The second pair resembles the first and corresponds in size. The three posterior pairs are shorter than the two first; they are slender and feeble, and carry a short basecphysis fringed with hairs that are jointed and ciliated; the ischium is armed on the posterior under surface with a strong tooth nearly as long as the joint; the meros is slightly lobed on the inner side, and is furnished with two strong spines and five or six ciliated hairs; the carpos is nearly as long as the meros and lobed on the inner side anteriorly, the lobe being furnished with one small spine and several long and ciliated hairs; the propodos is shorter than the carpos, lobed on the inner side anteriorly, but less so than the carpos, the lobe being fringed with four or five ciliated hairs, but no spines; the dactylos is longer than the propodos, the margins are subparallel, increasing rather than decreasing in width until near the apex, where they approach and terminate in a slightly unguiculate point, the under margin being fringed with a few hairs.

The pleon is somewhat more slender than the carapace, and the sixth joint is abruptly narrower than the preceding, and possesses the indication of a lobe on the anterior dorsal extremity.

The telson is long, slender, tapering, and armed with three strong spines on each side, each spine being solitary and distant from the others.

Leptochela gracilis, Stimpson (Pl. CXXXIX. fig. 2).

Leptochela gracilis, Stimpson, Proc. Acad. Nat. Sci. Philad., p. 111, 1860.

Carapace cylindrical. Rostrum subequal with the ophthalmopod.

Pleon smooth; fifth somite posteriorly produced to a horizontal tooth; sixth somite furnished with a tubercle near the anterior dorsal extremity.

Length, entire,	. . . . .	18 mm. (0·7 in.).
,,	of carapace, ...	6 ,,
,,	of rostrum, ...	3 ,,
,,	of pleon, ...	12 ,,
,,	of third somite of pleon, ...	3 ,,
,,	of sixth somite of pleon, ...	4 ,,
,,	of telson, ...	4 ,,

Habitat.—Station 233A, May 19, 1875 ; lat. 34° 38′ N., long. 135° 1′ E.; off Japan ; depth, 50 fathoms ; bottom, sand. Two specimens ; one male. Dredged.

The carapace is smooth, slightly carinated on the anterior portion, and produced to a pointed rostrum, which is depressed anteriorly. The dorsal surface is smooth. The pleon is slightly carinated to the posterior extremity of the fifth somite, which is produced to a sharp point in the median line. The sixth somite is considerably narrower, and is armed with a small tooth on the dorsal surface near the anterior extremity, and with a small and slender spine-like tooth near the posterior extremity of the infra-lateral margin.

The telson is long, slender, tapering, armed laterally with three strong, solitary, equidistant spines, and terminating in two long spines ; the dorsal surface is channelled in the median line.

The ophthalmopoda are more slender than in the previous species ; the ophthalmus is orbicular.

The first pair of antennæ has the peduncle longer than the rostrum, and has the first joint excavate to receive the eye ; the flagella are unequal, one being nearly half the length of the animal, and the other scarcely half the length of the carapace.

The second pair of antennæ has the scaphocerite longer than the peduncle of the first pair, and carries a flagellum that is broken off in our three specimens, but which Stimpson says is scarcely longer than that of the first pair.

The pereiopoda correspond closely with those of *Leptochela serratorbita.*

Observations.—This species, the specimens of which were procured off the southern coast of Japan, corresponds with the description of those taken by Stimpson in the Gulf of Kagosima. The only points that do not correspond with it are the presence of a small tooth or tubercle on the anterior portion of the sixth somite of the pleon, and the small slender tooth on the infra-lateral margin near the posterior extremity. In the female the form of these is frequently reduced to a small point.

It may be that Stimpson's description was taken from a female, but if so, the specific name does not correspond, and it is less slender and graceful than the male. In the female the anterior somites of the pleon have the lateral or coxal walls deeper than in the male.

The ova are oval, very numerous and small, being less than 0·5 mm. in diameter.

Stimpson's specimens were taken at a depth of more than 40 fathoms.

Leptochela robusta, Stimpson (Pl. CXXXIX. figs. 3, 4).

Leptochela robusta, Stimpson, *loc. cit.*, p. 112.

"Animal robust, slightly compressed. Carapace carinated. Rostrum slender, shorter than the ophthalmopoda.

"First pair of antennæ scarcely longer than the carapace, having the peduncle robust.

"Second pair of antennæ having the scaphocerite broad but acutely triangular.

"Mandibles having the psalistoma undivided.

"Pereiopoda broad.

"Pleon having the antepenultimate (fifth) somite neither carinated nor armed with a spine. Generally resembles *Leptochela gracilis*, but is much more robust.

"Length one inch" (Stimpson).

The preceding is a translation of Dr. Stimpson's diagnosis of the species. The specimens in the Challenger collection are not as a rule so large, although some of them are laden with ova.

Length, entire (female),	. . . . .	25 mm. (1 in.).
„ of carapace,	. . . . .	7 „
„ of rostrum,	. . . . .	1 „
„ of pleon,	. . . . .	18 „
„ of third somite of pleon,	. . . .	3 „
„ of sixth somite of pleon,	. . . .	4 „
„ of telson,	. . . . .	4 „

Habitat.—Station 162, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ 0″ E.; off East Moncœur Island, Bass Strait; depth, 38 fathoms; bottom, sand and shells. Sixteen specimens; males, and two females with ova.

In June 1874 a single specimen was taken, probably a little south of Sydney, and near the surface, since it was preserved in the same bottle with the Zoeæ and young of other species.

Dr. Stimpson obtained his specimens at the depth of 20 fathoms in the China Sea, and also near the Loo Choo Islands.

This species corresponds with *Leptochela gracilis* very closely in all important structural characters, excepting that the fifth somite is not produced posteriorly to a point.

The sixth somite is rather shorter, and has a very small tubercle on the anterior dorsal surface.

There is a close resemblance in the form of the appendages to those of the two previous species.

It differs from the description given by Stimpson, with which it coincides in many points, in having the rostrum as large as the ophthalmopoda, the longer flagellum of the

first pair of antennæ longer than the carapace, and in having the posterior portion of the fifth somite carinated in the dorsal median line.

The telson is long, tapering, dorsally grooved, laterally armed with three distant spines, and terminates in two short median, and four long outer spines.

In all the specimens taken the posterior two pairs of pereiopoda are reversed, that is, they have the dactylos pointed anteriorly instead of posteriorly as it usually is.

Pasiphæa, Savigny.

Pasiphæa, Savigny, Mem. sur les animaux sans vert., p. 50.

Animal laterally compressed. Carapace short, not produced to a rostrum but furnished with a large tooth on the dorsal crest. Mandible without a synaphipod. First and second pairs of gnathopoda chelate, posterior three pairs feeble and imperfectly developed and furnished with basecphyses. Pleon long. Rhipidura well developed. Telson short.

Carapace less than one-third of the length of the body of the animal, laterally compressed, and not so deep anteriorly as posteriorly. Frontal margin having the orbit slightly excavate and imperfectly defined. The first antennal tooth represented as an angle of the frontal margin projecting between the antennæ; the second antennal tooth forms a well-defined tooth standing slightly within the frontal margin, and directed obliquely forwards, thence the frontal margin recedes and meets the corresponding margin of the lateral wall at a more or less obtuse angle.

The pleon is laterally compressed, and the sides are deep; the somites are longitudinally subequal, the sixth being the longest.

The telson is laterally compressed, dorsally flat, and tapers towards the extremity. The ophthalmopoda are short, robust, and carry no ocellus.

The first pair of antennæ is biramose, and has the first joint of the peduncle excavate on the upper surface and furnished with a stylocerite.

The second pair of antennæ has a long flagellum and carries a scaphocerite that is distally armed with a tooth.

The mandibles are shell-shaped (conchiform), without molar process or synaphipod, and consist of a serrate psalistoma.

The first pair of siagnopoda is small and three-branched.

The second pair of siagnopoda consists of a narrow ovate plate, projecting anteriorly and posteriorly, and fringed with ciliated hairs that radiate towards the anterior distal extremity; on the inner side is a narrow cylindrical process tipped with a few hairs.

The third pair of siagnopoda consists of a long, narrow, membranous plate, tapering from the base to the distal extremity. The outer angle of the base is stouter, more membranous, and is imperfectly articulated with the rest; from the articulation the

outer margin proceeds in a straight line to the distal extremity, the inner margin tapers towards the outer, and the distal extremity is semiarticulated with the rest by an imperfect division, which gives a leaf-like appearance to the part, both margins of which are fringed with hairs, while the inner margin is armed with a small tooth-like projection.

The first pair of gnathopoda is seven-jointed and subpediform, the three terminal joints being reflexed and curved backwards, and carries neither ecphysis nor mastigobranchial appendage.

The second pair of gnathopoda is pediform and four-jointed, the basis and ischium being probably united, and the terminal joint long, narrow, and without a dactylos ; the coxa carries no appendage, but the basis supports a robust ecphysis that is generally attached by a small pedicle.

The first two pairs of pereiopoda are subequal in form, both are chelate, long, and slender, the hand is narrow, and the fingers long ; both pairs carry a stout basecphysis. The third pair is about half the length of the preceding, it is seven-jointed, carries a basecphysis, is extremely slender, and terminates in a long and styliform joint. The fourth pair is considerably shorter than the third ; it is equally slender, seven-jointed, and carries a basecphysis, the terminal joint being short, compressed, and distally furnished with a brush of hair. The fifth pair is longer than the preceding and more robust ; it is seven-jointed, carries a basecphysis, and terminates in a short and broad dactylos, tipped with a brush of hair.

The first pair of pleopoda has one branch long and multiarticulate, and the other short and membranous. The second and following pairs are subequally biramose, the inner branch being furnished with a long and slender stylamblys, tipped with a bundle of cincinnuli.

The posterior pair assists in the formation of the rhipidura ; it is biramose, long, foliaceous, and the outer branch is furnished with a diæresis.

The branchial arrangement consists of eight plumes, of which the anterior five are the largest. The first two are attached to the membranous articulation of the first pair of pereiopoda, the third and fourth belong to the articulation of the second pair of pereiopoda, and the fifth and sixth to that of the third pair ; the seventh and eighth are not attached to the membranous articulation, but to the interstitial process of the somites of the pereion. The branchial arrangement is represented in the following table :—

	h	i	k	l	m	n	o
Pleurobranchiæ,	...	...	...	...	...	1	1
Arthrobranchiæ,	...	...	2	2	2	...	...
Podobranchiæ,	...	...	...	...	...	...	...
Mastigobranchiæ,	...	...	...	...	...	...	...

Observations.—This genus was established by Savigny and placed by him in close relation to the genera *Penæus* and *Sergestes*, to the latter of which it possesses a general

resemblance, particularly in the feeble condition of the posterior pair of legs, but it differs in the character of the branchiæ, the form of the third pair of pereiopoda, and in the manner of carrying the ova.

I have not examined the plan of the nervous system nor the development of the embryo, but anticipate that they will be found to be more in accordance with those of the Phyllobranchiata than with those of the Dendrobranchiata.

Geographical Distribution.—The species of this genus at present known are not numerous, and the specimens scarcely more so. *Pasiphæa sivado*, Risso, is found in the Mediterranean and in the Scandinavian seas, where it was taken at the depth of 100 fathoms.[1] *Pasiphæa tarda*, Kröyer, has also been found in the Norwegian waters, as also *Pasiphæa norvegica*, Sars. *Pasiphæa cristata* was taken with the trawl near the Fiji Islands, and *Pasiphæa amplidens* is found near Japan, *Pasiphæa acutifrons* in the Strait of Magellan, and its near ally *Orphania tenuimana* off the eastern coast of North America. These species, together with *Pasiphæa savignyi*, Leach, and *Pasiphæa brevirostris*, Milne-Edwards, from unknown localities, are evidence of the rarity of the species and the paucity of the individuals. They appear to be very extensively distributed in depth, ranging from a few fathoms to over a mile and a half. A scarcity of specimens may be due to our want of knowledge of the habits of the animal and the localities which it most frequents.

Pasiphæa cristata, n. sp. (Pl. CXL.; Pl. CXLI. fig. 1).

Laterally compressed. Carapace one-fourth the length of the animal, measured from the frontal margin to the extremity of the telson; dorsal surface rounded, not carinated; frontal margin not advanced to a rostrum between the ophthalmopoda, frontal region in the median line elevated, with a laterally compressed triangular crest. Orbits imperfectly excavate and defined by an outer obtusely pointed canthus, beneath which, but less advanced, is the rounded projection that represents the first antennal tooth, and still more retiring is a distinct and well-formed tooth that corresponds with the second pair of antennæ, beneath which the frontal margin still recedes and unites with the lateral margin, forming an obtuse angle, from which posteriorly the sides of the carapace gradually deepen.

Pleon dorsally smooth, rounded, and laterally compressed; first somite shorter than the succeeding, second and three following subequal, and sixth much longer than the preceding. Telson about half the length of the sixth somite.

Ophthalmopoda moderately broad.

First pair of antennæ having a stylocerite that is sharply pointed, and nearly as long

[1] Mr. John Murray has recently (1887) dredged large numbers of *Pasiphæa sivado*, of all sizes, in Loch Fyne, Loch Etive, Loch Aber, and Loch Carron, in the west of Scotland, in depths of from 50 to 100 fathoms, on a muddy bottom. Their stomachs contained fine mud.

as the first joint of the peduncle, second and third joints cylindrical and subequal in length, being about half the length of the first joint, flagella subequal in length, upper stout at the base.

Second pair of antennæ having a scaphocerite that is half as long again as the peduncle of the first pair, narrow and lanceolate; flagellum long and slender.

Anterior two pairs of pereiopoda having the chelæ long and narrow, the second pair having the fingers longer than those of the first; in both they cross each other when closed. Following three pairs small, feeble, carrying a strong stiff basecphysis.

Pleopoda stout, except the terminal pair, which is longer than the telson.

Length, entire,	68 mm. (2·6 in.).
„ of carapace,	16 „
„ of pleon,	52 „
„ of third somite of pleon,	9 „
„ of sixth somite of pleon,	12 „
„ of telson,	7 „

Habitat.—Station 173, July 24, 1874; lat. 19° 9′ 35″ S., long. 179° 41′ 50″ E.; off Matuku, Fiji Islands; depth, 315 fathoms; bottom, coral mud. One specimen, female. Dredged.

The appearance of this species is that of an animal that has been subjected to constant lateral pressure, the whole animal being so evenly flattened. The dorsal surface is not carinated, nor compressed to a ridge, but is smooth and rounded; the depth of the carapace increases posteriorly in a line that is continuous with the lower margin of the coxal plates of the pleon until the sixth somite, which is less deep, being much longer than the preceding, and twice the length of the telson.

The ophthalmopoda are short and stout, and support an ophthalmus that is quite black and somewhat greater in diameter than the stalk, the whole being supported on a pedicle that is abruptly and considerably smaller.

The first pair of antennæ is about half the length of the animal, having the peduncle nearly half the length of the dorsal surface of the carapace; the first joint is fully equal to the two next, and carries on the outer side a sharply pointed stylocerite of great tenuity, which has the distal extremity twisted to a right angle with the basal portion, and is nearly as long as the joint, the inner side is deep, straight, and flat, being compressed against the corresponding margin of the other appendage. The upper and lower surfaces are hollowed, the former to receive the ophthalmopod, and the latter to make way for the second pair of antennæ, leaving the inner surface as a wall standing both above and below the extremely thin structure of the joint, and free from hairs or cilia. The two succeeding joints are cylindrical, the second is shorter than the third, and

together they do not quite equal the first in length. The outer and upper flagellum is swollen at the base for a short distance, and then gradually narrows to a diameter which corresponds with that of the lower flagellum, and the under surface of the enlarged portion is flat or hollowed, and carries a mat of membranous cilia.

The second pair of antennæ carries a scaphocerite that is long, narrow, and has the two margins correspondingly curved to meet at the extremity, where the outer is produced to a small tooth; the outer margin is smooth and rigid, and the inner thickened by a fringe of strong hairs; the ultimate joint of the peduncle is half the length of the scaphocerite, and much stouter than the flagellum, which is about half the length of the animal.

Behind these latter appendages in the median line the epistoma projects in the form of a laterally compressed, anteriorly directed, lobe-like beak, between which and the metastoma the mandibles are enclosed.

The mandibles (Pl. CXLI. fig. 1*d*) are short, broad, and shell-shaped, and consist of the psalistoma only, the molar process and synaphipod being absent.

The first pair of siagnopoda (fig. 1*e*) is small and three-branched; the outer branch is subcylindrical, unarmed, except for two hairs, one short and simple and the other extremely long and minutely serrate; the middle branch is broad and armed with long, strong, curved spines, and the inner branch is short, and armed with short, straight spines.

The second pair of siagnopoda (fig. 1*f*) consists of a broad, foliaceous plate of considerable tenuity, surrounded with hairs that radiate as from a common centre, all bending towards the anterior apex; on the inner end, attached to the plate as part of the same structure, is a short, subcylindrical branch, tipped with three or four minutely serrate hairs.

The third pair of siagnopoda (fig. 1*g*) consists of a long, foliaceous plate of considerable tenuity; the basal part has the outer portion separated by a broad, imperfect articulation, from which the structure gradually narrows towards the extremity, forming a long acute triangle, the distal portion of which forms the apex, and is divided from the rest by an obscure articulation, at the base of which on the inner side is a tooth-like prominence; the margin is distally fringed with long hairs that increase in length towards the extremity.

The first pair of gnathopoda (fig. 1*h*) is six-jointed, subpediform, short, narrow, and cylindrical; the coxa is short and stout, the basis is longer, and the ischium is long and narrow, and slightly flattened; the meros resembles the ischium, and the carpos is short, triangular, and articulates with the meros at a right angle. The propodos is long, cylindrical, and reflexed; the dactylos is broad, distally attached to the propodos, and directed posteriorly, and is fringed with short, stout spinules on the outer margin, and apically with one long and straight. This appendage is so closely associated with the preceding, that to all appearance the two are connected as represented in the Plate. Even when

treated with a reagent, it is difficult to determine their separation from each other, but the absence otherwise of the third pair of siagnopoda convinces me as to the homological relation of the two appendages.

The second pair of gnathopoda is long, slender, and five-jointed; the coxa is short, the basis but a little longer, and supports a broad, multiarticulate ecphysis that reaches as far as the distal extremity of the next succeeding joint, which probably consists of the ischium and meros fused together; it is longitudinally depressed on the upper surface, and slightly curved on the inferior to allow of free passage over the oral appendages; the next joint, which I take to represent the carpos, is cylindrical, and about half the length of the preceding; the terminal joint, which therefore represents the propodos, is half as long again as the carpos, and of the same diameter, it is cylindrical at the carpal extremity, and flattened and somewhat spatuliform at the rounded distal end, which is thickly tipped on the inferior margin with serrate hairs, and on the superior margin with equidistant, solitary, curved hairs.

The first pair of pereiopoda (Pl. CXL. *k*) is long and slender, reaching beyond the distal extremity of the scaphocerite; the coxa is short, and carries an ecphysis supported on a small pedicle, the base suddenly enlarging from the pedicle, it is cylindrical, and terminates in a multiarticulate extremity, which reaches beyond the ischium, which is long, slender, and laterally compressed on the outer side for the reception of the robust ecphysis; the meros is long, slender, and slightly compressed laterally, it is twice the length of the ischium, and small throughout; the carpos is short and slightly larger at the propodal than at the carpal extremity; the propodos is long, narrow, and chelate; the palm is twice the length of the carpos, and subequal in length with the pollex and dactylos, which correspond with each other in form, being long, slender, and curved; the points where the chela is closed overlap each other considerably, and the inner margin is deeply serrate (*k'*).

The second pair of pereiopoda resembles the first in form and appearance, but is a little longer, a circumstance that is due to a variation in the length of different parts; the coxa and basis are similarly formed to those of the first pair, and the latter supports a closely similar ecphysis, but the ischium is shorter, while the meros is much longer, being six or eight times as long as the ischium, and is armed with a small sharp tooth on the inferior margin, about one-third of its length from the ischial articulation; the carpos and palm are nearly the same length, but the fingers are longer than in the first pair, and are more strongly serrate. This serrature is peculiar, consisting of a series of processes that are flattened and pointed and stand on a long base in the case of the dactylos, and in the case of the pollex are rounded at the apex, slightly curved, and stand on a short base; in both pollex and dactylos they are directed obliquely forwards and possess a spiral structure.

The third pair of pereiopoda (*m*) is short and slender, and carries a short basecphysis

that is attached by a small pedicular articulation ; the ischium is short and about half the length of the ecphysis ; the meros is long and slender, the carpos short and narrow, and the propodos long, slender, and tapering, the extremity being broken off in our specimen; the dactylos, which is probably minute, is missing. The fourth pair of pereiopoda (*n*) is much shorter than the third, and differs from it in having the propodos cylindrical and not tapering, being as broad at the distal as at the meral extremity ; the dactylos is short, broad, and flat, and tipped with hairs.

The fifth or posterior pair of pereiopoda (*o*) is considerably longer than the fourth and stouter than the third ; it is formed as in the preceding, but differs in the shape of the dactylos, which is flattened and increases in diameter distally, where it terminates in a rounded extremity ; the distal and inner margin being fringed with long and short hairs respectively.

The branchiæ (Pl. CXL. fig. 2) of this species are peculiar, but from the small number and size of the specimens I have not had the opportunity to determine if the condition be generic or not. There are none corresponding with the gnathopoda, while those that belong to the first two pairs of pereiopoda are attached to the membranous portion of the coxal articulation, and are of equal size and importance ; those of the third pair are unequal, and those of the posterior two pairs are attached to the interstitial portion of the somites of the pereion and therefore are pleurobranchiæ, while the former are arthrobranchiæ as shown in the table given under the genus.

The pleopoda are biramose and multiarticulate. The first pair (*p*) has the outer ramus long, slender, and fringed with ciliated hairs ; the inner ramus is short, flat, and membranous, of great tenuity, and fringed with short, strong, ciliated hairs on the posterior and distal surfaces respectively, and on the anterior margin there is a pointed process that I take to be the rudiment of a stylamblys. The second (*q*) and all the following pairs have the branches subequal in length, the inner, which carries a long, cylindrical, narrow stylamblys, tipped with cincinnuli, being narrower than the outer. The terminal pair, which helps to form the rhipidura, has the outer branch much longer than the inner, and is traversed by a diæresis (*v*) that is imperfectly defined on the outer margin, and does not reach the inner, which like both margins of the inner branches is fringed with strong and ciliated hairs.

In our specimen, which I consider to be a female, there is a mass of parasitic cell-growth (fig. 3) strung together in a bead-like arrangement and suspended from a common centre. On casual inspection the appearance as seen through the thin structure of the integument is that of a mass of ova peculiarly arranged, but closer and more careful examination demonstrates the parasitical nature of the growth.

The specimen was associated with one of *Sergestes*, so much like it in general appearance, although smaller, that it might easily have been taken for a younger specimen.

Pasiphæa amplidens, n. sp. (Pl. CXLI. fig. 2).

Carapace dorsally straight, rounded, smooth, without a carina; frontal margin without a rostrum; frontal region dorsally crested in the form of a sharply pointed, obliquely elevated, and laterally compressed tooth; it is broad at the base longitudinally, and anteriorly directed. The orbits are but sparingly excavate and imperfectly defined by a small projection. The first antennal tooth is reduced to a prominence, but the second is developed to a large tooth, whence the margin recedes backwards and then at right angles downwards, then rounds off to form the lateral margin of the carapace, which gradually descends posteriorly to near the base of the second pair of pereiopoda, when it is gradually directed upwards.

The ophthalmopoda are short, standing on distinct pedicles, and distant from each other; the ophthalmus is globular, of larger diameter than the peduncle, and possesses no ocellus.

The first pair of antennæ has the first joint deeply excavate and furnished with a stylocerite, which is sharply pointed and twisted anteriorly so as to become vertical; the inner margin is expanded, and flattened by compression against its fellow. The second and third joints are short and cylindrical and carry two flagella, of which the upper is the more robust.

The second pair of antennæ carries a scaphocerite that reaches beyond the distal extremity of the peduncle of the first pair, and is about half the length of the carapace, the inner and outer margin corresponding, each being curved towards the apex, the outer angle of which is furnished with a tooth, and the inner margin is fringed with hairs.

The mandibles are similar to those of *Pasiphæa cristata*, but have a larger number of teeth (thirteen) on the incisive margin, and the tooth that forms the lower angle is rather large and somewhat thickened, as if it were the rudiment of the molar tubercle.

The siagnopoda also closely resemble those of *Pasiphæa cristata*, but there is an interesting variation in the third pair in the more definite distinction of the distal extremity of the appendage from the basal portion, and in the semiarticulated portion of the outer basal division being more acutely produced.

The first pair of gnathopoda is associated with the third pair of siagnopoda, and in form and appearance closely resembles those of *Pasiphæa cristata*.

The second pair of gnathopoda is long, slender, and pediform; it carries a stout basecphysis and terminates in a long narrow joint with parallel margins, flattened towards the distal extremity and fringed with short hairs and spinules.

The first two pairs of pereiopoda are chelate. The first pair is long, slender, and smooth; the second pair has the posterior margin of the meros strongly serrate, and

both have the chela long, fringed, with their margins serrate, but the system of dentation is somewhat different; the teeth are sharper, more resembling each other on the pollex and dactylos, and fall more obliquely forward.

Habitat.—Station 236, June 5, 1875; lat. 34° 58′ N., long. 139° 29′ E.; depth, 775 fathoms; bottom, green mud; bottom temperature, 37°·6. One specimen, fragmentary. Trawled.

Our only specimen is imperfect, the pleon with its appendages and all the pereion and its appendage posterior to the second pair of pereiopoda are wanting; but what remains is sufficient to identify it as a distinct species from any other known to me.

The length of the carapace is about 19 mm., and assuming that it is about one-third of the length of the animal, or a little less, we may consider the entire length of the perfect animal to be from about 75 to 80 mm., or about three inches.

Pasiphæa acutifrons, n. sp. (Pl. CXLI. fig. 3).

Carapace one-third of the length of the animal, laterally compressed, dorsally carinated, and anteriorly armed with a strong sharp tooth abruptly elevated over the frontal region; anterior margin in front of the tooth not carinated, slightly advanced between the ophthalmopoda, but not enough to form a rostrum. Orbits imperfectly excavate; first antennal tooth feeble; second antennal tooth small but well defined, thence the frontal margin recedes until it meets the lateral margin of the carapace, which gradually recedes obliquely to the posterior margin.

Pleon slightly carinated on the second and following somites.

Telson (fig. 3z) laterally compressed, dorsally grooved, posteriorly forked, and nearly as long as the sixth somite of the pleon.

The ophthalmopoda short, stout, and standing on a small pedicle.

The first pair of antennæ having the first joint of the peduncle excavate on the upper surface, and armed with a stylocerite that is sharply pointed and as long as the joint; the two succeeding joints are short, subequal and cylindrical, and carry two flagella that are very slender and about half the length of the animal.

The second pair of antennæ has a scaphocerite that reaches beyond the distal extremity of the peduncle of the first pair, and gradually tapers to a point, which is armed on the outer angle with a strong tooth.

The gnathopoda correspond with those of the preceding species.

The first two pairs of pereiopoda also agree, excepting that both pairs have the posterior margin of the meros armed with teeth, but these are few in number, and fewer on the first than on the second. The three following pairs are short, slight, and correspond with the generic type.

The pleopoda are subequal in length and correspond in form with those of *Pasiphæa cristata*.

The telson is shorter than the plates of the rhipidura.

Length, entire,	. . . . .	47 mm. (1·9 in.).
„ of carapace,	. . . . .	15 „
„ of rostrum,	. . . . .	...
„ of pleon,	. . . . .	32 „
„ of third somite of pleon,	. . . .	5 „
„ of sixth somite of pleon,	. . . .	9 „
„ of telson,	. . . . .	7 „

Habitat.—Station 311, January 11, 1876; lat. 52° 45′ 30″ S., long. 73° 46′ 0″ W.; off Port Churruca, Patagonia; depth, 245 fathoms; bottom, blue mud; bottom temperature, 46°·0. One specimen. Trawled.

Station 236, June 5, 1875; lat. 34° 58′ N., long. 139° 29′ E.; south of Japan; depth, 775 fathoms; bottom, green mud; bottom temperature, 37°·6. One specimen. Trawled.

Orphania,[1] n. gen.

Carapace more than one-third the length of the animal, anteriorly produced to a rostral point. Frontal crest not adorned with a strong tooth.

Ophthalmopoda well developed.

First pair of antennæ biflagellate.

Second pair of antennæ supporting a foliaceous scaphocerite.

Second pair of gnathopoda pediform.

First two pairs of pereiopoda slender and chelate. Second pair longer than the first. Three succeeding pairs feeble.

Five anterior somites of pleon subequal; sixth longer than the preceding.

Telson tapering to a point.

Orphania tenuimana, n. sp. (Pl. CXLI. fig. 4).

Carapace about one-third of the entire length of the animal, dorsally subcarinated, anteriorly produced to a small point. Orbit well defined.

Pleon dorsally rounded; anterior five somites subequal, sixth subequal with the two preceding.

Telson long, slender, and tapering to a sharp point, armed with a small tooth on each side.

[1] ’ορφανία, the condition of an orphan.

Ophthalmopoda short and cylindrical.

First pair of antennæ biflagellate, and scarcely as long as the carapace.

Second pair of antennæ having a broad scaphocerite, armed with a tooth on the outer distal extremity, and carrying a slender flagellum.

Second pair of gnathopoda pediform.

First pair of pereiopoda narrow, chelate; second pair chelate and longer than the first; third pair about half the length of the second; fourth pair about half the length of the third, and feeble and slender; fifth pair a little stouter and slightly longer than the fourth, but not so long as the third; all the pairs carry a broad and stout basecphysis.

Pleopoda moderate in size and biramose, excepting the first pair, which has the inner branch resembling a small bud-like process; all are attached to the lateral margin of the coxal plates. Sixth pair long, narrow, and reaching beyond the extremity of the telson; inner branch lanceolate and fringed with hairs; outer rounded, the external margin being furnished with a strong tooth, and the inner fringed with hairs; no evidence of a diæresis.

Length, entire,	20	mm. (0·8 in.).
,, of carapace,	7	,,
,, of rostrum,	0·5	,,
,, of pleon,	13	,,
,, of third somite of pleon,	2	,,
,, of sixth somite of pleon,	3	,,
,, of telson,	3	,,

Habitat.—Station 45, May 3, 1873; lat. 38° 34′ N., long. 72° 10′ W.; south-east of New York; depth, 1240 fathoms; bottom, blue mud; bottom temperature, 37°·2. One specimen. Dredged.

This species corresponds much in general form with *Pasiphæa tarda*, Kröyer,[1] but differs in the length of the flagella of the first pair of antennæ, and in the more important character of the development of the coxal plates of the somites of the pereion; it also has the propodos of the second pair of pereiopoda proportionately longer than Kröyer's species.

The carapace is less laterally compressed than in the more typical species of *Pasiphæa*, and is distinguished by an elevated line that runs from the antennal tooth to the posterior portion of the branchial wall, but does not reach the posterior margin. The frontal margin projects to a small rostral point between the ophthalmopoda, it carries no dorsal crest, but a very slight carina traverses the anterior portion in the median line.

The somites of the pleon differ somewhat in length; the first is the shortest and is

[1] Voy. en Scandinavie, Atlas, pl. vi. fig. 1*a*, 1846.

laterally produced to a narrow point, from the extremity of which the first pair of pleopoda proceeds; the second, third, and fourth somites are of similar length, and have the coxal plates developed in a slightly squamous form, and carry the pleopoda attached to the inner wall of the margin. The fourth somite is slightly longer than the preceding, and has the coxal plate not developed in a squamous form, but as a process near the posterior extremity, to which the pleopod is attached. The fifth somite is slightly shorter than the fourth but resembles it in form. The sixth is nearly as long as the preceding two, is considerably compressed laterally, and carries the sixth pair of pleopoda at its posterior margin, which combine with the telson to form the rhipidura.

The ophthalmopoda are stout and cylindrical; the ophthalmus is not of larger diameter than the stalk, and in this respect it differs from Kröyer's figure of *Pasiphæa tarda*, in which the ophthalmus is larger than the peduncle.

The first pair of antennæ appears to be rather shorter than the carapace, but the extreme ends of the flagella are broken off; the first joint is concave on the upper surface for the reception of the ophthalmopod.

The second pair of antennæ also has the flagellum broken, and carries a scaphocerite that is broad at the distal extremity, armed with a small tooth on the outer distal angle, and bears hairs upon the outer margin.

The oral appendages have not been examined, as the specimen is unique and not very perfect.

The second pair of gnathopoda is pediform, but terminates in an obtuse extremity, which reaches nearly as far as the distal extremity of the scaphocerite.

The first pair of pereiopoda is shorter and more robust than the second, it has the propodos but little longer than the carpos and slightly stouter; the fingers are stout at the base, slightly curved, and pass each other at their apices. The second pair is much longer than the first, each joint being slightly longer relatively than the corresponding joint of the first pair; the propodos is much longer and terminates in a pollex and dactylos that are longer, more slender, sharper, and slightly curved. The three posterior pairs are short and slender, the last two being subequal and shorter than the third pair.

The pleopoda are connected with the respective somites at the lateral margins, and are not remarkably long.

The telson is a little shorter than the lateral branches of the rhipidura.

Family Oodeopidæ.

Carapace short, anteriorly produced to a long horizontal rostrum. Pleon long, generally armed with teeth. Ophthalmus long, ovate. First pair of antennæ biflagellate. Second pair furnished with a scaphocerite and a slender flagellum. Mandible without a

synaphipod. Second pair of gnathopoda long, slender, and pediform. First pair of pereiopoda chelate or subchelate and larger than the second, which is simple like the others posterior to it.

Oodeopus, n. gen.

Carapace about one-fourth the length of the animal. Rostrum long and slender.

Pereion narrow and subcylindrical.

Five anterior somites of pleon subequal, the sixth longer than the preceding.

Telson long, narrow, the terminal extremity fringed with hairs.

Ophthalmopoda short; ophthalmus large, ovate.

First pair of antennæ biflagellate.

Second pair of antennæ furnished with an obtusely-pointed scaphocerite.

Mandibles without synaphipod.

The second pair of gnathopoda long, slender, pediform and six-jointed, and carrying a basecphysis.

First pair of pereiopoda large and chelate. Second pair robust, but more slender than the first and simple. All the pereiopoda carry a basecphysis.

Pleopoda biramose, posterior pair not longer than the telson.

Observations.—The description of this genus is drawn from an immature animal, but the one that is in the most advanced stage of development in the collection, and which shows a tendency to develop the first pair of pereiopoda into a chela in the adult stage. All the other specimens exhibit them in the simple form, which I take to be a still more immature condition.

It bears comparison with a young animal which Dana has figured under the name of *Rachitia spinalis*,[1] which he captured in the Atlantic, off the harbour of Rio Janeiro, on January 7, 1838. It, however, differs from this genus in having the rostrum short, in the first pair of antennæ having only a single flagellum, and in the form of the telson. It must, however, be the young of some closely allied genus, of which the one taken as the type in this collection is in the most advanced condition, and exhibits evidence of the relation it bears to an older form.

Geographical Distribution.—Most of those found were taken in the Eastern Seas. Four different forms that appear to represent separate species were procured off Cape York, one off Cape Jackson, one off the New Hebrides, and one off Cape Verde in the Atlantic. Dana took his specimen of *Rachitia* off the coast of Brazil.

[1] U.S. Explor. Exped., Crust., p. 667, pl. xliv. figs. 8*a–b*.

Oodeopus geminidentatus, n. sp. (Pl. CXLII. fig. 1).

Carapace smooth; anteriorly produced to a long rostrum, serrate at the lateral margins. Fronto-lateral angle produced to a long, style-like tooth.

Pleon long and narrow; five anterior somites subequal. First somite dorsally smooth, second armed with two teeth at the posterior margin, one on each side of the median line; third, fourth, and fifth somites similarly armed with two teeth; sixth somite about the length of the two preceding, and posteriorly armed on the dorsal surface with one long, spine-like tooth.

Telson a little shorter than the sixth somite.

Length, entire,	8	mm.	(0·3 in.).
,, of carapace,	2	,,	
,, of rostrum,	3	,,	
,, of pleon,	6	,,	
,, of third somite of pleon,	0·5	,,	
,, of sixth somite of pleon,	1·6	,,	
,, of telson,	1·5	,,	

Habitat.—Cape York, September 8, 1874.

The carapace is about one-fourth the length of the animal, slightly elevated to a small protuberance on the dorsal crest over the frontal region, and anteriorly produced to a rostrum that is one-third longer than the carapace, dorsally depressed, and laterally widened and tapering to the apex, the margin long, serrate with a number of small teeth; the median line on the lower surface of the rostrum is depressed below the lateral margins. The orbital excavation is slight, and extends nearly to the fronto-lateral angle of the carapace, which is produced to a long, narrow, and spine-like tooth, reaching as far as the extremity of the peduncle of the second pair of antennæ; posteriorly to this tooth the lateral margin of the carapace is finely serrate for a short distance, whence it is smooth to the posterior extremity.

The pleon is about three times as long as the carapace, the first somite is dorsally smooth, but all the others are armed; the four succeeding somites have each two teeth at the posterior margin, while the lower marginal angles are slightly produced to a small obtuse point; the sixth somite is dorsally armed at the posterior margin with a long, slender tooth, and on each side at the infero-distal angle with a sharp tooth.

The telson (fig. 1z) is nearly as long as the sixth somite; the lateral margins are nearly parallel, and terminally slope to a point in the median line, where it is armed with a long, robust spine, on each side of which there are eight spines, four smaller and three succeeding larger ones, and a distant one still smaller on the outer margin.

The ophthalmopoda are short, and terminate in a large, oval-shaped ophthalmus, the larger diameter of which is near the posterior extremity.

The first pair of antennæ has the peduncle reaching to about half the length of the rostrum, and terminates in two short, immature flagella.

The second pair of antennæ has the peduncle reaching nearly as far as the distal extremity of the eye, and has the second joint armed with a long, spine-like tooth on the outer distant angle, and on the inner with a long and slender foliaceous scaphocerite, fringed on the inner margins with long hairs. The flagellum is in an immature condition, and does not reach to the extremity of the scaphocerite.

The mandibles have no synaphipod.

The second pair of gnathopoda is six-jointed, and carries a basecphysis that reaches to nearly the extremity of the meros; the succeeding joints are subequal, the terminal one being more slender than the preceding, somewhat shorter, and tipped with hairs.

The first pair of pereiopoda is slender at the base, and carries a two-jointed basecphysis, tipped with long hairs. It gradually increases in diameter until it reaches the broadest part at the distal extremity of the carpos, whence to the distal extremity of the palm of the propodos the width gradually lessens, and the inferior angle projects to a small point which represents the pollex, against which the longer dactylos impinges. The second pair of pereiopoda, although tolerably robust, is much more slender than the first pair, and terminates in a simple dactylos; like the preceding it is furnished with a biarticulate basecphysis. The following three pairs of pereiopoda are more slender than the second, and terminate in a sharply pointed, simple dactylos; each pair is furnished with a biarticulate basecphysis, that is slightly longer than the preceding.

The pleopoda are still in an immature condition, and are all biramose, except the first pair, which appears to be wanting. The posterior pair, which forms part of the rhipidura, has the two branches subequal but neither as long as the telson.

Observation.—It is almost impossible as yet to determine what may be the adult characters of the specimens of which this and the following species are the undeveloped forms.

Oodeopus serratus, n. sp. (Pl. CXLII. figs. 2, 3).

Carapace smooth, dorsally depressed in the gastric region, anteriorly produced to a horizontally directed rostrum that is slightly waved and serrate on the lateral margins. The orbit is excavate to the infero-lateral angle, which is produced to a small but acute point, whence the lateral margin is serrate to the posterior margin of the carapace.

The pleon is three times the length of the carapace; the first somite is dorsally smooth, the second is armed with a large laterally compressed tooth, the carina of which commences at the anterior margin and terminates at the posterior, and reaches as far as

the posterior extremity of the fourth somite, each two succeeding somite is shorter than the preceding, and is serrate along the dorsal margin and posteriorly produced to a small tooth; the fifth somite is nearly as long as the two preceding, it is dorsally serrate and posteriorly projects to a strong tooth, but not more than half as long as the tooth on the second somite; the sixth somite is subequal with the length of the fifth, cylindrical, dorsally smooth, and posteriorly produced at the posterior extremity to a small tooth; the lower lateral angle is truncate.

The telson (fig. 2z) is little more than half the length of the preceding somite, slightly enlarging posteriorly, the posterior margin being armed in the median line with a long and straight tooth, and at the lateral angles with a slightly curved spine, the intermediate space on each side being fringed with small and finely ciliated hairs.

The ophthalmus is long, ovate, and tapers to a narrow, anteriorly projecting point, the peduncle being invisible.

The first pair of antennæ is about half the length of the rostrum, and supports two rudimentary flagella.

The second pair of antennæ carries a broad and foliaceous scaphocerite that is scarcely half the length of the rostrum and terminally fringed with long hairs, as also is the inner margin; the flagellum as yet is only rudimentary.

The oral appendages have not been examined, and the gnathopoda and pereiopoda are as yet in the biramose condition common to an early and immature state of the Macrura.

The pleopoda are in an incipient condition, except the sixth pair, which is about two-thirds the length of the telson, the two branches are subequal in length, the outer being armed on the outer distal angle with a long sharp tooth; the inner branch, as well as the inner margin of the outer branch, is very thickly fringed with fine ciliated hairs.

Length, entire,	6	mm. (0·2 in.).
„ of carapace,	1·5	„
„ of rostrum,	2·3	„
„ of pleon,	4·5	„
„ of large tooth,	0·8	„
„ of sixth somite of pleon,	1	„
„ of telson,	0·7	„

Habitat.—New Hebrides, August 23, 1874; Sibago, Philippines, and Cape Howe, Australia.

A slight variety of this species (fig. 3) was taken off Cape York, in which the serrature behind the fronto-lateral angle of the carapace is continuous only for a short distance, and there is no serrature on the dorsal surface of the rostrum; the pereiopoda are in a more advanced but still biramose condition.

This specimen was taken in the same locality as *Oodeopus geminidentatus* and has the following measurements :—

Length, entire,	8	mm. (0·3 in.).
„ of carapace,	3	„
„ of rostrum,	3·3	„
„ of pleon,	5	„
„ of large tooth,	1	„
„ of sixth somite of pleon,	1·4	„
„ of telson,	1	„

Observations.—These specimens appear to me to belong to the same genus as the preceding, but they are in a less advanced condition. That they are the young of a larger species is probable, inasmuch as one is as large in size, although in a younger stage.

Oodeopus armatus, n. sp. (Pl. CXLII. fig. 4).

Carapace dorsally smooth and anteriorly produced to a rostrum that is a little longer than the carapace.

Pleon three times as long as the carapace and armed dorsally on all the somites, excepting the first, with large teeth, the anterior of which is the largest, the others decreasing in size gradually to the last ; the sixth somite is subequal to the three preceding in length, and the telson is subequal with the sixth somite.

The ophthalmus is ovate, but less pointed anteriorly than in *Oodeopus serratus*.

The antennæ and pereionic appendages are still in an immature condition, and the terminal pleopoda, which appear to be the only pair developed, do not as yet reach the length of the telson.

Length, entire,	7	mm. (0·3 in.).
„ of carapace,	2	„
„ of rostrum,	2·4	„
„ of pleon,	5	„
„ of sixth somite of pleon,	1·5	„
„ of telson,	1·5	„

Habitat.—The New Hebrides, August 18 ; Cape York, September 6, 1874 ; surface.

Oodeopus intermedius, n. sp. (Pl. CXLIII. fig. 1).

Carapace about one-fifth the length of the animal, dorsally smooth, and anteriorly produced to a rostrum that is about three times the length of the carapace, and has the lateral margins serrate ; the fronto-lateral angle is short and the lateral margin slightly serrate near the anterior extremity.

The pleon is four times as long as the carapace, and has the first somite short and smooth, the second is dorsally armed with a tooth originating from the posterior margin,

and about half the length of the third somite, which is also armed with a shorter tooth at the posterior margin, as are also the fourth and fifth somites; the sixth is nearly as long as the two preceding, and posteriorly projects to a sharp tooth on the dorsal surface as well as at the postero-inferior angle.

The telson (fig. 1z) is nearly as long as the sixth somite, it is posteriorly produced to a long and slender tooth, and armed with several spines on either side.

The ophthalmus is long-ovate, and equals in length about a third of the carapace.

The first pair of antennæ is scarcely half the length of the rostrum, and the second has the flagellum still less developed.

The percionic appendages are in the biramose condition.

The pleopoda are still undeveloped, excepting the posterior pair (*v.v.*), which is unequally biramose, and but little shorter than the telson.

Length, entire,	. . . . .	7	mm. (0·3 in.).
„ of carapace,	. . . . .	1	„
„ of rostrum,	. . . . .	4	„
„ of pleon,	. . . . .	6	„
„ of sixth somite of pleon,	. . . .	1·3	„
„ of telson,	. . . . .	1·4	„

Habitat.—Cape York, September 6, 1874; surface.

Oodeopus duplex, n. sp. (Pl. CXLIII. fig. 2).

Carapace about one-fifth the length of the animal, dorsally smooth, anteriorly projecting to a long rostrum that is about half the length of the animal, and is armed along the lateral margins with a series of small teeth. The orbit is defined at the outer canthus by a small point and the fronto-lateral angle by another, neither being strongly pronounced; behind the fronto-lateral angle the margin is armed with a series of small teeth.

The pleon is four times as long as the carapace, and has the first somite dorsally smooth, the second armed with a long tooth, the third with a tooth subequal with it, and the fourth and fifth with shorter teeth; the sixth somite is equal in length to the three preceding, and is posteriorly produced to a sharp tooth.

The telson is as long as the sixth somite, has the margin posteriorly tapering, and armed on the dorsal surface and in the median line at the extremity with three spinules and a terminal tooth.

The ophthalmopoda are more than half the length of the carapace, and support a long-ovate ophthalmus.

The first pair of antennæ is about half the length of the rostrum and terminates in two short, incipient flagella.

The second pair of antennæ is furnished at the distal extremity of the second

joint on the outer side with a long and slender tooth, and on the inner with a scaphocerite.

The appendages belonging to the pereion are in the biramose condition, and those of the pleon are as yet undeveloped, except the sixth pair, which is subequally biramose, but does not reach as far as the extremity of the telson.

Length, entire,	7	mm. (0·3 in.).
„ of carapace,	1·5	„
„ of rostrum,	2·5	„
„ of pleon,	5·5	„
„ of dorsal tooth,	0·5	„
„ of sixth somite of pleon,	1·5	„
„ of telson,	1·5	„

Habitat.—New Hebrides, August 19, 1874; Cape York; Fiji Islands.

Oodeopus longispinus, n. sp. (Pl. CXLII. fig. 5).

Carapace one-fifth the length of the animal, dorsally smooth, and anteriorly produced to a long, horizontally straight rostrum, that has the lateral margins serrate. The orbit is not clearly defined; the fronto-lateral angle is short and the lateral margin is serrate to near the postero-lateral angle, where it becomes smooth.

The pleon has the first somite smooth, the second armed with a very long tooth, the front of which commences at the anterior margin of the somite, and the posterior margin coincides with that of the somite; the third somite terminates in a small dorsal tooth which is serrate on the upper surface; the fourth somite is also serrate towards the posterior extremity, and is produced to a small tooth; the fifth somite is serrate throughout its length and produced posteriorly to a long tooth that lies parallel with the dorsal surface of the sixth somite. The sixth somite is narrower and equal in length to the preceding two, it is dorsally smooth and posteriorly armed with a sharp, strong tooth, and on the under surface the posterior angle is also produced to a sharp tooth.

The telson (fig. 5z) is almost as long as the sixth somite, slightly increasing in width posteriorly, and has the terminal margin fringed with long spines, of which those at the lateral angles are the longer and are fringed with fine spinules.

The ophthalmus is long and somewhat reniform, and about one-fourth the length of the rostrum.

The first pair of antennæ is about half the length of the rostrum.

The second pair of antennæ is furnished with a scaphocerite that is armed with a long tooth at the outer distal extremity, and is subequal in length to the first pair of antennæ.

The appendages of the pereion are in the biramose condition.

The pleopoda are undeveloped, excepting the sixth pair, which is unequally biramose, the outer branch being a little shorter than the telson and the inner half its length.

Length, entire,	. . . . .	6·5 mm. (0·2 in.).
„	of carapace, ...	1·5 „
„	of rostrum, ...	2·5 „
„	of pleon, ...	5 „
„	of dorsal tooth, ...	5 „
„	of sixth somite of pleon, ...	1·3 „
„	of telson, ...	1·2 „

Habitat.—Celebes Sea, October 1874.

Oodeopus gibbosus, n. sp. (Pl. CXLIII. figs. 3, 4).

Carapace about one-third the length of the animal, anteriorly produced to a rostrum that is half the length of the animal, smooth at the margins. Orbit defined by a small point; fronto-lateral angle stoutly pointed, lateral margin smooth, posteriorly descending beyond the ventral surface of the pereion.

Pleon having the first somite smooth and flat, the second elevated to a decided hump, the third smooth and rounded, the fourth dorsally smooth, and laterally produced at the posterior angles to a long and sharp tooth on each side; the sixth somite is narrow and smooth, increasing in diameter at each extremity.

Telson (fig. 3z) nearly as long as the sixth somite, having the margins subparallel, slightly wider at each extremity, the posterior being excavate in the median line and fringed with hairs, of which the smallest is towards the middle on each side of a small median tooth and a larger tooth at the angles, and two small hairs on the lateral margin near the base of the teeth at the angles. The hairs are all fringed with small points, but the teeth are smooth.

The ophthalmus is ovate, and projected on a narrow peduncle.

The first pair of antennæ is about half the length of the rostrum.

The second pair of antennæ supports a scaphocerite that reaches as far as the distal extremity of the peduncle of the first pair, and a flagellum that is about two-thirds the length of the scaphocerite.

The appendages of the pereion are biramose so far as they are developed, but the posterior two pairs are still in a state of gemmation.

The pleopoda are as yet undeveloped, with the exception of the sixth pair (fig. *v. v.*) which is unequally biramose, the outer branch reaching as far as the distal extremity of the telson; it, as well as the inner branch, is fringed with hairs on the inner and distal margins, but is not armed with a tooth on the outer margin.

Length, entire,	7	mm. (0·3 in.).
„ of carapace,	2	„
Depth of carapace,	1·25	„
Length of rostrum,	3·5	„
„ of pleon,	5	„
„ of sixth somite of pleon,	1·25	„
„ of telson,	1·75	„

Habitat.—Cape Verde, April 26, 1876.

Tribe Haplopodea.

This tribe is established to receive all those genera in which the pereiopoda are simple and resemble each other, none of them being chelate or having the carpos multi-articulate.

The tribe may be divided into separate families according to the structure and development.

Family Hectarthropidæ.

This family is established to receive those Macrura that have all the pereiopoda similar in structure to each other, consist of six joints only, and in which every limb except the last supports a basecphysis.

Procletes,[1] n. gen.

Animal rigid. Carapace about one-third the length of the animal, anteriorly produced to a long rostrum, which is serrate on the upper and lower margins. The frontal margin is armed with a supraorbital and a small orbital tooth, another tooth corresponding with the second antennæ, and one at the fronto-lateral angle.

The pleon is dorsally carinated and armed with teeth; the sixth somite is subequal with the fifth and the telson, which is tapering.

The first pair of antennæ is biramose.

The second pair of antennæ has a scaphocerite that has the outer margin rigid and distally armed with a tooth.

The gnathopoda and pereiopoda are six-jointed, pediform, not chelate, and furnished with a basecphysis, except the posterior pair.

The sixth pair of pleopoda has the rami subequal and foliaceous.

Geographical Distribution.—Only two species of the genus have been observed. The first was taken by the late Sir Walter Elliot at Waltair, on the coast of Coromandel,

[1] προκλητης, "Challenger."

and that in this collection was dredged in the shallow Sea of Banda, off the south-western coast of New Guinea.

Procletes biangulatus, n. sp. (Pl. CXXVII. fig. 4).

Carapace armed on the dorsal surface with a tooth at the posterior extremity, and others on the frontal crest, continued regularly on the upper margin of the rostrum to its apex. The rostrum reaches to twice the length of the carapace, and has the lower margin armed with teeth corresponding to those on the upper surface. On the lateral walls of the carapace are three carinæ, and the frontal margin is furnished with a large supraorbital tooth and a large antennal tooth.

The pleon has the dorsal surface armed with teeth, the third somite having two, an anterior and a posterior.

The telson is long and tapering, laterally armed with two or three small spinules.

Length, entire,	16 mm. (0·6 in.).
„ of carapace,	5 „
„ of rostrum,	10 „
„ of pleon,	11 „
„ of dorsal tooth,	3 „
„ of sixth somite of pleon,	2 „

Habitat.—Station 191, September 23, 1874; lat. 5° 41′ 0″ S., long. 134° 4′ 30″ E., off the Arrou Islands; depth, 800 fathoms; bottom, green mud; bottom temperature, 39°·5. One specimen. Trawled.

The carapace has the dorsal surface broad and angular; the median line is carinated from the posterior margin to the rostrum, which is laterally compressed from the base to the apex. The dorsal surface is armed near the posterior margin with a strong, anteriorly directed tooth, whence the edge is smooth to the gastric region, where a series of small regularly planted teeth commences and continues along the upper margin of the rostrum to the distal extremity, as well as on the lower margin, from just beyond the extremity of the ophthalmopod, posterior to which the margin is smooth. The frontal margin has the orbit defined by a small orbital tooth, below which a large, obliquely directed tooth, corresponding with the second antenna, forms the anterior extremity of a small but conspicuous ridge; beneath this tooth there exists a small fronto-lateral angle. Viewed dorsally the fronto-orbital region is flattened out and bounded by a ridge that commences posteriorly at the pyloric region, and anteriorly terminates in a long, spine-like, supraorbital tooth, that reaches nearly to the ophthalmus, and is midway armed with a small tooth. Commencing at the posterior margin a lateral carina runs obliquely

to the hepatic region, where it meets another that also commences at the posterior margin of the carapace, and horizontally traverses the lateral walls; the two unite and continue for a short distance as a single ridge, which dies out just below the one that corresponds with the antennal tooth.

The pleon has the somites subequal in length, increasing a little posteriorly; the first is dorsally smooth and a little elevated in the centre; the second is armed with a small, anteriorly directed tooth situated nearer the anterior margin, but not on it; the third is dorsally carinated, and produced to a tooth both at the anterior and posterior extremity, the anterior tooth being directed forwards and obliquely upwards, and the posterior, which is the longer, directed backwards, reaching as far as the middle of the fourth somite, which also is posteriorly produced to a sharp-pointed tooth, as is likewise the fifth, but the sixth has none.

The telson is long and gradually narrows to the apex, which is armed with two or three small hairs, and on the lateral walls with two or three small distal spinules.

The ophthalmopoda are large, pyriform, and quite equal in length to half the carapace; the ophthalmus is large, being fully equal to half the length of the ophthalmopoda in diameter.

The first pair of antennæ reaches to about half the length of the rostrum, and terminates in two flagella which are subequal in length with the peduncle, the inner being the more robust.

The second pair of antennæ is a little longer than the rostrum, and carries a scaphocerite that is foliaceous, long and narrow, slightly narrowing to the distal extremity, fringed on the inner margin with fine hairs, and strengthened on the outer margin with a strong, smooth edge, that terminates at the distal extremity in a long and slender tooth.

The mandibles have not been examined, as I did not wish to injure the specimen.

The second pair of gnathopoda is pediform and six-jointed; the second joint supports a leaf-like ecphysis, and it terminates in a short, sharp-pointed dactylos.

The first pair of pereiopoda and all the other pairs correspond in form, but gradually increase in length posteriorly; they all carry a leaf-like basecphysis except the posterior pair, which is the longer, and does not carry an ecphysis.

The pleopoda are short and biramose. The sixth pair has the branches subequal, and about the same length as the telson.

Observations.—This species is of much interest, and it is to be regretted that there is only a single specimen in the collection. Some years since the late Sir Walter Elliot, F.R.S., took, off Waltair, on the coast of Coromandel, a specimen of which I have a carefully drawn figure before me. It differs only specifically from that which I have just described, and I wish to record it under the name of *Procletes ellioti*, in honour of its original discoverer. It resembles *Procletes biangulatus*, but differs from it in having

the lateral walls of the carapace free from carinæ, the supraorbital teeth not so long, the flagellum of the second pair of antennæ shorter than the rostrum, and the telson longer than the sixth pair of pleopoda.

Icotopus,[1] n. gen.

Carapace dorsally smooth, anteriorly crested, produced to a long rostrum, serrate on the upper and lower margins. Frontal margin furnished with a supraorbital tooth, and with a large fronto-lateral tooth.

Pleon having the somites subequal; sixth somite a little longer than the fifth.

Telson long, tapering, and sharp pointed.

Ophthalmopoda long, pyriform.

First pair of antennæ biflagellate.

Second pair of antennæ long and slender, and supporting a foliaceous scaphocerite armed with a tooth at the distal extremity.

Gnathopoda and pereiopoda formed on the same type, all being simply pediform or not chelate.

Branchiæ as in the following table :—

Pleurobranchiæ,	.	.	.	...	...	1	1	1	1	1
Arthrobranchiæ,	.	.	.	...	...	...	...	...	...	...
Podobranchiæ,	.	.	.	...	...	...	...	...	...	...
Mastigobranchiæ,	.	.	.	1	1	...	...	...	...	...
				h	i	k	l	m	n	o

Geographical Distribution.—The only species yet known belongs to the Australian seas.

Icotopus arcurostris, n. sp. (Pl. CXLIV. fig. 1).

Carapace smooth, anteriorly crested, and produced to a long rostrum that is slightly arched, and armed on the upper surface with a series of teeth, and on the lower margin with a few at the distal extremity; lateral margin fringed with a few teeth posterior to the fronto-lateral angle.

Pleon dorsally smooth; telson longer than the sixth somite.

Ophthalmopoda pyriform, half the length of the rostrum.

First pair of antennæ shorter than the rostrum.

Second pair of antennæ as long as the animal.

Appendages of the pereion gradually increasing in length posteriorly until the posterior pair, which is not quite so long as the preceding.

[1] εἰκός, like ; πούς, foot.

Posterior pair of pleopoda shorter than the telson.

Length, entire,	10	mm. (0·4 in.).
„ of carapace,	3	„
„ of rostrum,	3·5	„
„ of pleon,	7	„
„ of sixth somite of pleon,	1·5	„

Habitat.—April 3, 1874; off Cape Howe, Australia. Two specimens were taken at the surface at night.

The carapace is dorsally smooth, but slightly depressed over the gastric region, anterior to which, on the frontal region, the crest is elevated and anteriorly produced to a rostrum that is a little longer than the carapace; it is serrate on the upper margin with thirteen teeth, of which the posterior two are postorbital and supported by a small tubercle, and the anterior is distant from the apex of the rostrum; the under margin is smooth and arcuate towards the base for one-half the length of the rostrum, beyond which it is armed with six teeth, the most distal of which is distant from the apex, but beyond the distal tooth on the upper margin. The frontal margin is armed with a long and slender supraorbital tooth (fig. 1c), which stands at the upper margin of the orbit, and is continuous with a ridge that strikes the dorsal median line near the pyloric region; the outer canthus of the orbit is rounded, and beyond it there stands a small first antennal tooth, whence the marginal line descends slightly posteriorly to the fronto-lateral angle, which is produced to a long and slender tooth, posterior to which on the lateral margin are four strong teeth that gradually decrease in size, and behind them the lateral margin is smooth to the posterior margin of the carapace.

The pleon is dorsally smooth and all the somites are subequal in length until the sixth, which is a little longer than the preceding, and is also narrower and less deep.

The telson is longer than the sixth somite.

The ophthalmopoda are long in the stalk and pyriform, and reach to half the length of the rostrum.

The first pair of antennæ is excavate on the upper surface of the first joint, which is subequal in length with the ophthalmopoda, and is armed on the outer margin with a short stylocerite. The second and third joints are short, cylindrical, and continuous with the first; there are scarcely definite articulations separating the joints which support the flagella, the outer of which is the more robust and strongly multiarticulate, the inner being more slender and obscurely multiarticulate.

The second pair of antennæ is broken off in the typical specimen at a point about equal to half the length of the animal, but from its diameter I should judge that when perfect it is at least twice as long. The peduncle is short and supports a scaphocerite that is longer than the ophthalmopod, subfoliaceous, having the margins parallel

and the extremity rounded and like the inner margins fringed with ciliate hairs, and armed on the outer distal extremity with a strong tooth; the second joint of the peduncle is furnished at the outer angle with a sharp tooth.

The mandibles (fig. 1*d*) are short, robust, and have neither synaphipod nor molar process; the psalistoma is prominent and sharp; behind it on the margin are several minute teeth or spinules.

The first pair of siagnopoda is three-branched; the two basal branches are broad and foliaceous, and the distal narrow; all supporting a few spine-like hairs.

The second pair of siagnopoda (fig. 1*f*) is four-lobed; the two basal on the inner side are bilobed, and tipped with long simple hairs, the distal is narrow and furnished with hairs on the inner side and at the tip, the outer side being smooth; the fourth or outer lobe is broad, projects anteriorly and posteriorly beyond the others, and is fringed with hairs, of which a few at the posterior margin are extremely long and directed backwards, the others fringe the margin from the posterior extremity to the anterior, gradually increase in size, and are directed forwards.

The third pair of siagnopoda (fig. 1*g*) or maxillipedes consists of two foliaceous plates on the inner surface fringed with hairs, of which the distal is narrow and the basal broad, and on the outer side a long and slender ramus distally tipped with a few hairs.

The first pair of gnathopoda is short and pediform; the ischial and meral joints are broad, concavo-convex, and fringed with hairs; the basisal joint carries an ecphysis that is double the length of the leg, and the coxa supports a divided mastigobranchia.

The second pair of gnathopoda is longer and more robust than the first, it terminates in a sharply pointed dactylos, and is furnished with a very long and slender multiarticulate basecphysis, and the coxa carries an undivided mastigobranchia.

The first pair of pereiopoda is long, cylindrical, and pediform; the coxa and basis are long, the latter carrying an ecphysis that is subequal in length with the leg; the meros is long, the carpos short, the propodos longer, and the dactylos tapering, and terminating in a styliform unguis. The other pereiopoda correspond in form but gradually increase in length until the posterior pair, which is slightly shorter.

The pleopoda are biramose and smooth, as if not yet fully developed. The posterior pair is more advanced, is subequally biramose, fringed with hairs, and the outer margin near the distal extremity is armed with a strong tooth.

The branchiæ consist of five pairs, one to each pair of pereiopoda; these represent as many pleurobranchiæ, all of which are comparatively large and well developed.

One of the specimens showed the nerve-ganglia very distinctly through the dermal structure, and it appeared as if the several somites of the pereion were connected by one large neural mass, while those of the pleon consisted of large globular ganglia, situated near the posterior extremity of each successive somite, connected together by a fine cord.

Observations.—The specimens taken were of different sizes, that described being

the largest. The degree of development shows that as yet the animal is not fully matured, but the parts described are such as are not likely to vary much in form but only in relative proportions. The ecphysis may fall off at a later stage, and the pleopoda increase in size and become ciliated, but the simple condition of the pereiopoda is not likely to alter, nor the form of the gnathopoda to become changed.

I know of no recognised adult Crustacean that corresponds so nearly with the preceding genus as *Procletes*, from which it chiefly differs in the number of teeth on the frontal region.

Hectarthropus, n. gen.

Carapace short, anteriorly produced to a horizontally smooth straight rostrum. Dorsal crest armed with a single tooth in the median line, orbit not well defined, frontal surface furnished with a supraorbital and two antennal teeth and one at the fronto-lateral angle.

Pleon long and slender.

Ophthalmopoda pyriform.

First pair of antennæ biflagellate.

Second pair of antennæ furnished with a long scaphocerite.

Mandible without a synaphipod.

Second pair of gnathopoda pediform.

Pereiopoda simple, six-jointed, the second joint being long, slender, and furnished with a basecphysis.

Hectarthropus exilis, n. sp. (Pl. CXLIV. fig. 2).

Carapace about one-eighth the length of the animal, produced anteriorly to a smooth, short rostrum; dorsal crest armed with one small tooth. Orbital region having a long supraorbital tooth; outer antennal region with a long antennal tooth; fronto-lateral angle produced to a small tooth, behind which the lateral margin is fringed with small teeth for a short distance.

Pleon long and slender; five anterior somites subequal; sixth as long as the two preceding.

Telson longer than the sixth somite.

Length, entire,	9	mm. (0·3 in.).
„ of carapace,	1·4	„
„ of rostrum,	1	„
„ of pleon,	7	„
„ of sixth somite of pleon,	1·5	„
„ of telson,	1·8	„

Habitat.—October 23, 1874; off Basilan Strait, Philippine Islands; taken at the surface.

The carapace is short, being scarcely one-eighth the length of the animal, it is dorsally armed with a small tooth on the cardiac region and another over the frontal crest, and anteriorly produced to a sharply pointed smooth rostrum, on each side of which the frontal region is extended to a long and slender supraorbital tooth, whence the walls descend more abruptly to the lateral margin, the anterior extremity of which is serrate to the fronto-lateral angle, above which and just within the margin stands a long and slender antennal tooth.

The pleon is long; the three anterior somites are subequal in length and dorsally unarmed, the succeeding two are shorter, the fourth being dorsally smooth, but the fifth, while smooth in the median line, is armed with a sharp tooth on each side on the dorsal surface. The sixth somite is longer than the preceding two, it is dorsally smooth and laterally compressed to a greater extent than the others, and is armed on each side at the posterior margin with a long sharp tooth, and ventrally in the median line with a strong tooth.

The telson is long and slender.

The ophthalmopoda are thick, clavate, and one-fourth longer than the rostrum; the ophthalmus is broader than the peduncle, which gradually narrows to the base, which is projected on a short stalk.

The first pair of antennæ has the peduncle very long, longer than the carapace; the first joint is nearly twice the length of the ophthalmopod, the upper margin is excavate and gives the joint an inferiorly arcuate appearance, the distal extremity is thickened to support the short second and third cylindrical joints, which carry two short flagella, the longest of which is not half the length of the peduncle.

The second pair of antennæ has the flagellum not reaching to the extremity of the first pair, and carries a scaphocerite that is long and narrow, rigid on the outer margin, and distally armed with a tooth that reaches subequally with the first joint of the first pair.

The oral appendages have not been examined.

The first pair of gnathopoda is subpediform, and carries a long basecphysis.

The second pair of gnathopoda is pediform, six-jointed, carries a basecphysis that is nearly as long as itself, and terminates in a short, sharp, unguiculate dactylos.

The first pair of pereiopoda is a little longer than the second pair of gnathopoda, carries a similar basecphysis, and terminates in a long and slender unguiculate dactylos, each articulation being supported by one or two simple hairs. The second pair of pereiopoda is rather more robust than the preceding, is furnished with a similar basecphysis, and terminates in a sharp unguiculate dactylos; the inferior angle of the propodos is armed with a long stiff serrate spine. The third pair of pereiopoda is sub-

equal in length with the preceding, but more slender, and terminates in a long, sharp, straight, unguiculate dactylos; the basecphysis is broken off, but the process on which it stands is large and prominent, and suggestive of supporting a large appendage. The two succeeding pairs of pereiopoda are broken off at the distal extremity of the basisal joints, which are long and robust, the penultimate being bilobed like that of the third pair.

The first pair of pleopoda is single-branched, the others are biramose. The sixth pair is subequal in length with the telson; the outer branch is furnished with a small denticle on the outer distal angle, and is fringed with hairs on the inner margin, as are also both margins of the inner ramus.

Hectarthropus compressus, n. sp. (Pl. CXLIV. fig. 3).

Carapace about one-fifth the length of the animal, anteriorly produced to a straight slender rostrum that is nearly half the dorsal length of the former; armed on the frontal crest with a strong tooth in the median line, and another small anteriorly directed tooth on the post-cardiac region, with a long supraorbital tooth on each side of the base of the rostrum, and one post-marginal corresponding with the second pair of antennæ. The fronto-lateral margin is slightly serrate.

The fifth somite of the pleon is posteriorly bidentate, a small tooth standing on the posterior margin, one on each side of the median line. The sixth somite is longer than the carapace, and much compressed laterally.

The telson is about two-thirds the length of the carapace.

Length, entire,	11	mm. (0·4 in.).
„ of carapace,	2	„
Depth of carapace,	1·5	„
Length of rostrum,	0·8	„
„ of pleon,	9	„
„ of sixth somite of pleon,	3	„
„ of telson,	2	„

Habitat.—Pacific; between Api and Cape York; surface. One specimen. Associated with *Sergestes* and *Oodeopus*.

This specimen corresponds with *Hectarthropus exilis*, which was taken at the Philippines, and I should have considered them as being one species but for important variations in the measurement of certain parts. The animals are of about the same length, being 9 mm. and 11 mm. respectively, but the difference may be even less, since *Hectarthropus compressus* is much more stretched, the pleon being considerably curved. A reference to the tables of measurements will show the relative differences in the lengths of corresponding parts.

The ophthalmopoda in *Hectarthropus compressus* reach to the extremity of the rostrum, whereas in *Hectarthropus exilis* they are nearly half longer; the frontal extremity of the lateral margin of the carapace is strongly serrate in *Hectarthropus exilis*, whereas in *Hectarthropus compressus*, though the serrature is present, the toothing is but feebly marked, while the tooth on the post-cardiac region of the carapace is more strongly pronounced, and those on each side of the posterior margin of the fifth somite are less so.

Observations.—These measurements are important distinctions, but still they may be dependent on the variability of growth; but until that is determined, it is desirable that the form should be noticed in its relation to other specimens.

Hectarthropus expansus, n. sp. (Pl. CXLIV. figs. 4, 5).

Carapace dorsally as broad as long, anteriorly produced to a sharp, smooth rostrum, and armed on the frontal crest with a short tooth; supraorbital tooth large, and projecting anteriorly; second antennal tooth large.

Pleon dorsally smooth in the median line; second somite armed with a tooth on the anterior margin of the coxal plate; fifth somite armed with a tooth at the posterior margin on each side of the dorsal surface.

Telson as long as the sixth somite.

Length, entire,	7	mm. (0·25 in.).
„ of carapace,	2	„
„ of pleon,	5	„
„ of third somite of pleon,	0·5	„
„ of sixth somite of pleon,	1	„
„ of telson,	1	„

Habitat.—October 23, 1874; off Basilan Strait, Philippine Islands; at the surface. Associated with the preceding species.

The carapace is expanded dorsally, and not laterally compressed as in the preceding species. It is anteriorly produced to a smooth, straight rostrum, that is about one-third the length of the carapace, and is dorsally armed on the frontal crest with a short stout tooth. From the base of the rostrum the frontal margin obliquely recedes to the supraorbital tooth, which projects above the orbit, the outer portion of which is seen as an excavation between the preceding and the orbital tooth that forms the outer canthus. The second antennal tooth stands as a large, oblique, anteriorly directed tooth, whence the frontal margin descends, projecting anteriorly to the fronto-lateral angle, posterior to which the lateral margin is serrate, with a series of four or five teeth; behind this serration the margin is smooth to the posterior extremity.

The pleon has the first somite divided, as in the preceding species, into an anterior and posterior section, but instead of the lateral walls being compressed, the antero-lateral margin of the coxal plate is expanded outwards to an obtuse point. The second somite is likewise divided into two portions, and the coxal plate projects both anteriorly and posteriorly over the adjoining somites, the anterior margin of the former being armed with a large, strong, sharp tooth that is directed obliquely forwards. The third and fourth somites are subequal in length, dorsally smooth, and laterally compressed, the compression increasing posteriorly. The fifth somite is shorter and laterally more compressed than the preceding; it is smooth in the median line, and on each side it is dorsally armed on the posterior margin with a strong tooth. The sixth somite is cylindrical, and twice the length of the preceding somite.

The telson is subequal in length with the sixth somite, and slightly narrows posteriorly, where it terminates in a straight line fringed with short hairs.

The ophthalmopoda are pyriform, and are projected on a short stalk, the ophthalmus being of slightly greater diameter than the peduncle.

The first pair of antennæ is enlarged at the base, and gradually narrows to a cylindrical shaft that reaches beyond the rostrum, where it carries two short subequal joints; the terminal joint supports two short (broken) flagella.

The second pair of antennæ has a short flagellum that does not reach beyond the apex of the rostrum (but this is probably due to the incomplete growth of the animal), and carries a large and broad scaphocerite with parallel margins that is subequal with the length of the peduncle of the first antennæ, and is rigid on the outer margin, and distally armed with a small tooth; the inner is fringed with a series of hairs.

The pereiopoda are all broken off at the extremity of the basisal joints, and the ecphysis are also wanting.

The pleopoda are short and in an incipient stage.

The sixth pair is subequal in length with the telson, broad and foliaceous, and except on the external margin of the outer plate fringed with hairs.

Hectarthropus tenuis, n. sp. (Pl. CXLIV. fig. 6).

Long and slender, carapace one-fourth of the length of the animal, anteriorly produced to a rostrum that is smooth on the lower margin, and dorsally armed with three teeth at the base.

Pleon having the fifth somite smooth; sixth somite subequal with the three preceding somites.

Telson half the length of the sixth somite.

Length, entire,	10	mm. (0·4 in.).
„ of carapace,	2·5	„
„ of rostrum,	1·2	„
„ of pleon,	7·5	„
„ of third somite of pleon,	2	„
„ of sixth somite of pleon,	3	„
„ of telson,	1·5	„

Habitat.—April 1876, North Atlantic, surface; probably near the Cape Verde Islands.

This species resembles *Hectarthropus exilis*, but may easily be determined by the form of the rostrum and the absence of the dorsal teeth on the posterior margin of the fifth somite of the pleon.

The carapace is armed on the dorsal crest with three teeth, whence the rostrum, produced to about half the length of the carapace, is slightly depressed and smooth on the upper and lower margins. The orbit is furnished with a supraorbital tooth of moderate size. The frontal margin is anteriorly produced, but is not armed with an antennal tooth as in other species, and the infero-lateral angle is produced to a strong tooth, from which point the margin is smooth.

The second somite of the pleon is longer than the first, and the third is longer than any except the sixth, which is equal in length to the three preceding.

The telson is about half the length of the sixth somite and gradually tapers to a sharp point.

The ophthalmopoda are clavate, and slightly longer than the rostrum.

The first pair of antennæ are biramose, but are not perfect.

The second pair is also broken, and the scaphocerite is not perfect.

The oral appendages have not been examined, and all the pereiopoda are broken off at the ischial joint, and all the ecphyses also, excepting those of the second gnathopoda and first pair of pereipoda, these are long and slender.

The pleopoda are short, biramose, and without cilia.

The posterior pair is slightly longer than the telson and furnished with a tooth on the outer margin.

Eretmocaris,[1] n. gen.

Carapace about one-fourth the length of the animal, anteriorly produced to a rostrum.

Pleon having the somites subequal; sixth a little longer than the fifth.

Telson subequal with the sixth somite.

Ophthalmopoda very long and supported on a long slender pedicle.

First pair of antennæ biflagellate.

[1] ἐρετμός, an oar; καρίς, a shrimp.

Second pair of antennæ carrying a long scaphocerite; flagellum slender and subequal with the length of the animal.

Pereiopoda pediform, slender, simple; the third, fourth, and probably the fifth pairs are long and remiform, each carrying a long basecphysis. The fifth pair in all the specimens has been broken at the basisal joint, which is remarkable for its very large diameter.

The pleopoda biramose.

Observations.—The first three pairs of appendages in this genus, the eyes, and two pairs of antennæ, are attached to a portion of the cephalon projected in front of the carapace, which still retains the embryonic ocellus.

Geographical Distribution.—Of the species of this genus one was taken in the Pacific, south of Japan, and three near the Cape Verde Islands in the Atlantic.

Eretmocaris remipes, n. sp. (Pl. CXLV. fig. 1).

Carapace anteriorly produced to a slender rostrum that is about half the length of the carapace, and armed with two teeth on the rostrum, the anterior being the smaller, and with one on the gastric region. Orbit not well defined, but a small tooth corresponds with the first antennal tooth, and a supraorbital tooth stands just above it; the fronto-lateral angle defined by a strong tooth, thence the lateral margin is smooth.

First pair of gnathopoda short and robust, terminating in an obtuse extremity, and carrying a long basecphysis.

Second pair of gnathopoda long, slender, and six-jointed, as are all the pereiopoda, each of which carries a long and slender basecphysis; the third and fourth pairs have the propodos enlarged and flattened near the middle and narrowing towards each extremity, and the dactylos is long and styliform; the fifth pair has the coxa and basis extremely large and robust; the rest of the appendage is lost.

Pleopoda, excepting the first pair, biramose, the posterior pair longer than the telson.

		Suhm's measurements.
Length, entire,	12 mm. (0·4 in.).	12·5 mm.
„ of carapace,	3 „	3 „
„ of pereion,	...	4·5 „
„ of rostrum,	1 „	1·5 „
„ of ophthalmopoda,	3 „	3 „
„ of first antenna,	9 „	...
„ of scaphocerite,	4 „	...
„ of pleon,	9 „	8 „
„ of third somite of pleon,	1·5 „	...
„ of sixth somite of pleon,	2 „	...
„ of telson,	2·3 „	...

Habitat.—North-west Pacific, south of Japan.

The carapace is about one-fourth the length of the entire animal, it is dorsally smooth except for a large tooth that surmounts the gastric region in the median line, and another that stands near the margin above the orbital angle. The rostrum is slender, smooth on the lower margin, and armed with two unequal teeth on the upper surface, of which the larger is the posterior, and situated about one-third from the base. The outer orbital angle is rounded, and tipped with a small tooth that I take to be the first antennal tooth, and the fronto-lateral angle is produced to a sharp point, whence the lateral margin is smooth to the posterior margin of the carapace.

The pleon is smooth; the five anterior somites are subequal in length, the sixth is longer and narrower, and the telson is longer than the sixth somite.

The ophthalmopoda are pyriform and projected on a long and slender cylindrical stalk; they are 4 mm. long, or about one-third the length of the animal; the ophthalmus is rounded. In front, beneath the base of the rostrum, a large globular lobe projects between the ophthalmopoda, on which exists a small ocellus.

The first pair of antennæ has the peduncle reaching nearly to the extremity of the ophthalmopoda; the first joint is long and armed at the outer side at the base with a sharp-pointed stylocerite, and is but imperfectly defined by a small prominence from the second joint; the third joint is short and cylindrical, and supports two long slender flagella, of which the upper is rather the more robust.

The second pair of antennæ is furnished with a scaphocerite that reaches beyond the distal extremity of the peduncle of the first pair, it is rigid on the outer side and is distally armed with a sharp tooth, and foliaceous on the inner side, the margin of which is fringed with hairs.

The oral appendages have not been examined.

The first pair of gnathopoda have not been carefully examined, but appear to be short, robust, and subpediform, with the distal joints reflexed.

The second pair of gnathopoda is long, slender, and pediform; it is six-jointed, and terminates in a sharp-pointed dactylos, and carries a slender subequally long basecphysis that has the margins parallel and the extremity blunt.

The first pair of pereiopoda is scarcely as long as the second gnathopoda, it resembles it in form and carries a similar basecphysis. The second pair resembles the first, but is a little longer and perhaps also more slender. The third pair is much longer than the second; the meros is extremely long, the carpos shorter, and the propodos, which is flattened and long, gradually increases and as gradually diminishes in diameter towards the dactylos, which terminates in a straight sharp-pointed dactylos. The fourth pair resembles the third, but is a little longer and terminates in a long, slender, styliform dactylos, and, like the preceding, carries a long, narrow basecphysis. The fifth pair is

wanting, being unfortunately broken off on both sides beyond the basisal joint, but the enormous size of the latter indicates that it supported a large appendage, which probably corresponds in form more or less closely with the preceding pair, but is without an ecphysis. The internal muscles are very strong and also support this conclusion.

The first pair of pleopoda is a powerful but single-branched appendage; the following pairs are all biramose, the terminal pair having the branches subequal and longer than the telson, the outer being armed with a tooth near the distal extremity, which shows no trace of a diæresis.

Eretmocaris longicaulis, n. sp. (Pl. CXLV. fig. 2).

Carapace less than one-fourth the length of the animal, dorsally smooth, except for a small tooth on the frontal crest, and anteriorly produced to a small rostrum.

Pleon dorsally smooth, having the somites subequal in length.

Telson as long as the sixth somite.

Ophthalmopoda projected on a pedicle that is longer than the animal.

First pair of antennæ nearly as long as the animal.

Second pair of antennæ having a scaphocerite equal in length with the first joint of the peduncle of the first pair.

Length, entire,	6	mm. (0·2 in.).
,, of carapace,	1·5	,,
,, of pleon,	4·5	,,
,, of ophthalmopod,	6·6	,,
,, of first antenna,	5	,,
,, of scaphocerite,	2	,,
,, of sixth somite of pleon,	0·8	,,
,, of telson,	1	,,

Habitat.—Station 227, March 27, 1875; lat. 17° 29′ N., long. 141° 21′ E.; south of Japan. The specimen was taken at the surface. It is labelled "Amphionid, 27 March 1875, W. Pacific."

The carapace, which is one-fourth of the length of the animal, is furnished on the gastric region with a small tooth and anteriorly produced to a small, sharply pointed rostrum. The frontal margin is not furnished with teeth, except the fronto-lateral angle which forms a small one.

The pleon is smooth and the somites subequal in length; the telson is rather longer than the sixth somite, and terminates in a sharp point.

The ophthalmopoda surpass in length that of the entire animal; the pedicle forms a long, slender, cylindrical stalk, which carries a pear-shaped organ at its extremity, which is furnished with a facetted ophthalmus.

The first pair of antennæ is scarcely as long as the ophthalmopod, and terminates in two subequal flagella, the outer of which is slightly larger than the inner. The peduncle which supports them is about half the length of the ophthalmopod; the first joint is very long and the other two are short.

The second pair of antennæ has a scaphocerite that is a little shorter than the peduncle of the first pair, rounded at the extremity, and has the inner margin fringed with hairs; the flagellum is longer than the scaphocerite.

The mandible has no synaphipod; the psalistoma is long and distally serrate, and the molar tubercle is robust. The supplementary oral appendages have not been accurately determined.

The first pair of gnathopoda is short and subpediform, but all the other appendages of the pereion with their ecphyses are broken off, but the remaining joints of the posterior pair indicate a larger organ than those anterior to it.

The pleopoda, except the first, which is single, are developed as short biramous appendages; the posterior pair is about once and a half as long as the telson.

Eretmocaris stylorostris, n. sp. (Pl. CXLV. fig. 3).

Carapace one-fourth the length of the animal, dorsally armed on the frontal region with a sharply pointed tooth, and anteriorly produced to a smooth rostrum that is about one-third the length of the carapace.

Pleon dorsally smooth; sixth somite twice the length of the fifth.

Telson two-thirds the length of the sixth somite.

Ophthalmopoda once and a half as long as the carapace.

First pair of antennæ about half the length of the animal.

Second pair of antennæ having the scaphocerite subequal with the length of the peduncle of the first pair.

Appendages of the pereion long and cylindrical; each being furnished with long basecphyses.

Length, entire,	4	mm. (0·2 in.).
„ of carapace,	1	„
„ of pleon,	3	„
„ of ophthalmopod,	1·5	„
„ of first antenna,	2·2	„
„ of scaphocerite,	1·4	„
„ of sixth somite of pleon,	1·4	„
„ of telson,	0·7	„

Habitat.—April 26, 1876; off Cape Verde Islands; taken at the surface.

The carapace is about one-fourth the length of the animal, armed on the dorso-frontal region with a strong horizontally directed tooth, and anteriorly produced to a long and

slender styliform rostrum; the frontal margin does not appear to be armed with a supraorbital or other tooth, and the fronto-lateral angle does not project beyond a right angle.

The pleon has the anterior five somites subequal in length, the third is slightly the longest, and overlaps the fourth on the dorsal surface, but it is not projected to a tooth; the sixth somite is as long as the preceding two, and the telson is about half the length of the sixth somite.

The ophthalmopoda are longer than the carapace, and at the base between them is a large orbicular lobe that is furnished at the posterior portion with a distinct ocellus; they are biarticulate, the first joint is a long and slender cylindrical stalk, supporting at its extremity an equally long and pear-shaped segment, at the extremity of which is the rounded facetted ophthalmus.

The first pair of antennæ is more than half the length of the animal, and terminates in two unequal flagella; the outer is the more robust, and is furnished with numerous sensory cilia, the inner being slender and longer; the peduncle is longer than the ophthalmopod, and slightly curves towards the distal extremity, the first joint is very long, the second is short, and the third still shorter, all being cylindrical.

The second pair of antennæ supports a scaphocerite that is nearly as long as the ophthalmopod; it is distally rounded, and the inner margin is fringed with hairs.

The mandibles do not carry a synaphipod, but are furnished with a serrate psalistoma and a strong molar prominence; this organ lies closely impacted between the anterior and posterior labia.

The supplementary oral appendages are small, and have not been closely examined as the specimen is unique.

The first pair of gnathopoda is short, pediform, and tolerably robust, but I could not be certain that it carries a basecphysis.

The second pair is long, slender, and six-jointed, and terminates in a short sharp-pointed dactylos, and the basis carries a long ecphysis.

The pereiopoda are formed on the same type as the second pair of gnathopoda. They are all six-jointed and cylindrical; the basis is comparatively long, and the ischium and meros appear to be united; the carpos is shorter, but proportionately longer than usual, the propodos is short, and the dactylos is short, pointed, and terminates in a small bristle. They are all furnished with a basecphysis, which is slender and subequal in length with the respective pereiopod, excepting the penultimate pair, in which it is not more than one-third its length. The fifth or ultimate pair of pereiopoda in this species, as in all the specimens of the other species, is broken off at the basisal joint, which from its large size (although in this species it is not so large as in some others) indicates that this appendage is of some peculiar significance in relation to the animal.

The pleopoda are not yet present, but traces of their development appear at the

margins of the fourth and fifth somites, while the anterior show no evidence of their presence, but the ventral surface in the median line of each somite is inferiorly lobed, and a mass of neural substance appears to be lodged in each. The sixth pair of pleopoda is unequally biramose, and extends beyond the telson for half its length.

Eretmocaris corniger, n. sp. (Pl. CXLV. fig. 4).

Carapace one-fourth the length of the animal, dorsally armed with a strong tooth on the gastric region, anteriorly produced to a rostrum, which is broken short off in this the only specimen obtained.

Pleon having a horn-like tooth on the dorsal surface of the third somite, curving anteriorly.

Telson as long as the sixth joint.

Ophthalmopoda as long as the carapace.

Scaphocerite longer than the ophthalmopod.

Appendages of the pereion having the basecphyses subequal with the pereiopoda.

Length, entire,	7	mm. (3 in.).
„ of carapace,	1·5	„
„ of rostrum (broken),	2	„
„ of pleon,	5·5	„
„ of third somite of pleon,	0·8	„
„ of sixth somite of pleon,	1·5	„
„ of telson,	1·5	„

Habitat.—Cape Verde, April 26, 1876.

The carapace is scarcely more than one-fifth the length of the animal; it is dorsally armed with a strong tooth in the median line of the gastric region, and anteriorly produced to a rostrum which is broken off in our specimen, so that its length cannot be determined. Near the middle of the orbit stands a large sharp tooth directed forwards, and the antennal angle is rounded off, as is also the fronto-lateral angle, behind which and within the margin stands a sharp tooth.

The anterior two somites of the pleon are subequal; the third is longer, and is armed with an anteriorly curved vertical tooth on the dorsal surface near the posterior margin; the fourth and fifth somites are shorter and subequal, the sixth is longer than the preceding two, and the telson is equal to the sixth somite.

The ophthalmopoda are biarticulate and subequal in length with the carapace; the basal joint being a long and slender stalk that is equal in length to the pyriform distal mass, which corresponds with the usual organ, the rounded extremity of which represents the reticulated ophthalmus.

The first pair of antennæ is longer than the ophthalmopod and terminates in two

unequal flagella, the peduncle of which does not reach to the distal extremity of the ophthalmus.

The second pair of antennæ supports a scaphocerite that is a little longer than the ophthalmopod, rounded at the distal extremity, which is fringed with hairs, and has the outer angle armed with a strong tooth; the flagellum is one-third shorter than the scaphocerite.

Amphion, Milne-Edwards.

Amphion, Milne-Edwards, Ann. Soc. Entom. France, tom. i. p. 336; Hist. Nat. Crust., tom. ii. p. 486.

In 1832, Professor Milne-Edwards, at a meeting of the Entomological Society of Paris, described a pelagic Crustacean of small size, and extremely pellucid, to which he gave the name of *Amphion*, and placed it as a new genus along with another that appeared to correspond much with it, to which Leach had given the name of *Phyllosoma*, in a family to which Milne-Edwards gave the name of Bicuirassés, and placed it among the Stomapoda.

The genus *Phyllosoma* has since been demonstrated to be the young and immature form of Crustacea belonging to the families of Palinuridæ and Scyllaridæ, but the position of *Amphion* is still uncertain, its true relation to the adult form not having been hitherto determined.

Although it possesses some general resemblance to *Phyllosoma*, it differs most importantly in structural characters, and belongs to a separate division of the order. The general outline of form is very different. In *Phyllosoma* the carapace is as broad as long and circular in form, and does not cover the pereion, which exists as a second somewhat circular disc posterior to it, whence Milne-Edwards derived the general name for the family.

In *Amphion* the carapace is long and narrow, and covers the pereion from the earliest to the latest stage of its known development.

Phyllosoma is known to leave the ovum with five pairs of appendages attached to the pereion, namely, two pairs of gnathopoda and three pairs of pereiopoda; but although *Amphion* has never been procured from the ovum, yet there are specimens in this collection in which the only appendages present besides the ophthalmopoda, antennæ, and oral organs, are the two pairs of gnathopoda, and they are only distinguishable from the Zoea of the Phyllobranchiate prawns by the presence of the sixth pair of pleopoda in an incipient condition. But even here these pleopods are not present as distinct organs, but are in an early state of gemmation, suggesting a progressive development which shows the animal to have existed for some time in a different condition prior to its previous moult. Our youngest specimen is about 5 mm. in length, and it is highly probable that the brephalos appears in the Zoea stage, whereas in *Phyllosoma* the pleon is in an

immature condition in the brephalos, which approaches the Megalopa stage and as yet no signs of the sixth pair of pleopoda are apparent, nor until after the animal has all the pereiopoda in an advanced condition. In fact, a continuous advance in the development to this point has not been observed in the *Phyllosoma* of the Palinuridæ.

The earliest form of *Amphion* in the collection (Pl. CXLVI. fig. 1) was taken in the Pacific, and is 5 mm. (0·2 in.) in length. It is slender, and much resembles the Zoea of other Macrura, excepting that the eye is pedunculated.

The carapace is about 2 mm. long, and covers the entire pereion; it is narrow, being only a little broader than the anterior somites of the pleon, and is anteriorly produced at the fronto-lateral angles to a small tooth, but there is no rostral point visible.

The pleon is 3 mm. long, and is composed of six somites; the five anterior are subequal, the first being furnished with a small anteriorly directed tubercle on each side, which I take to represent the pleocleis of the adult; the sixth somite is equal in length to all the preceding. It gradually narrows and terminates in a gradually widening, broad, ovate, foliaceous, and spatuliform plate, posteriorly fringed with hairs, one on each side of the median line being small, and six exterior to these long.

The first or cephalic somite is anteriorly produced in the median line, and furnished with a small, round ocellus; on the upper surface on each side originate the ophthalmopoda, of which the peduncle is short and the ophthalmus long-ovate, somewhat pyriform in shape, and about 1 mm. long, or about half the length of the carapace.

The first pair of antennæ is about 1 mm. long, and two-jointed; the first joint, which is extremely long, appears to represent the peduncle; the second, which is short, represents the flagellum.

The second pair of antennæ is a little longer than the first, and consists of a basal joint that supports two branches, the inner one represents the flagellum, which is uniarticulate, and reaches a little beyond the distal extremity of the first pair, and the outer is the scaphocerite, which is a little shorter than the flagellum, it is narrow at the base, and gradually enlarges distally; the extremity as well as the inner and outer distal margins are fringed with seven or eight long, slender hairs.

The oral appendages are at a considerable distance from the frontal margin of the cephalon, and implanted posteriorly to a semicircular epistoma.

The mandibles, which are immediately posterior to the epistoma, and on each side of the oral aperture, are sharply pointed, and do not carry a synaphipod.

The three pairs of siagnopoda, as far as can be determined by a general examination without dissecting them out, appear to resemble those that will be more fully described in a later stage.

At about the same distance posteriorly as the mouth is from the anterior margin of the cephalon, the first pair of gnathopoda is situated; it consists of a short coxa and a long basis, the extremity of which carries the four succeeding joints of the true leg

already distinguishable, the last of which is sharp and styliform; from the outer distal extremity of the basis proceed an ecphysis that consists of two joints, the basal one being very long and cylindrical, and the distal very short, cylindrical, rounded at the extremity, and tipped with three or four hairs.

The second pair of gnathopoda is somewhat larger than the first, is situated close behind, and resembles it in general form but is a little more robust.

None of the pereiopoda are yet visible even in a budding condition.

The pleon has as yet no appendages present, and no evidence of their future development is visible, except in an apparent gathering of granules in the position where the sixth pair of pleopoda are formed.

Two other specimens were captured, one (fig. 73), which is 6 mm. long, to the north of New Guinea, in February 1875, and the other, which is 5·1 mm. long, in the Pacific.

FIG. 73.—Zoea of *Amphion*. Dorsal surface. From a drawing by Dr. von Willemoes Suhm. Reduced one-half.

FIG. 74.—"Youngest larva taken by myself, following Dohrn's larva. Nat. size 8 mm., H. $\frac{1}{4} \times 12$. Ventral aspect." From a drawing by Dr. von Willemoes Suhm. Reduced one-half.

Neither of these differs materially from that which has been described. The latter has at the extremity of the peduncle of the first pair of antennæ a long cilia or hair attached to the extremity of both the inner and outer angle, and others at the apex of the single-jointed flagellum; and the posterior somite of the pleon exhibits the outline of the branches of the sixth pair of pleopoda, on which the marginal hairs are present within the outer tissue (Pl. CXLVI. fig. 2z) which are a little more defined in the specimen from New Guinea. These changes are probably consequent upon the internal growth that precedes another moult.

The next specimen (Pl. CXLVI. fig. 3) is also recorded from the Pacific; it is 8 mm.

(0·3 in.) in length, and has advanced in development as well as in size. It has three pairs of appendages attached to the pereion, or one pair more than is present in the preceding stage (fig. 74).

The carapace of this specimen is furnished with a small tooth or rostrum in the middle of the frontal margin, and the evidence of its future persistence exists in the presence of a tooth attached to the new or underlying tissue of the next succeeding moult. On the outer angle of the frontal margin a small tooth projects, corresponding with the outer canthus of the orbit, while the tooth previously noticed as standing at the fronto-lateral angle exists in a position further distant from the base of the second antennæ, as if some portion of the increase in length attained by the animal was due to growth anterior to this tooth. The somites of the pleon are nearly in the same relative condition as in fig. 1.

The appendages appear to have advanced a little, but rather in form than in importance.

The ophthalmopoda are longer in proportion, and the diameter is greater near the distal extremity.

The first pair of antennæ has developed two small spicules, one on each side of the peduncle, as if marking the position of a future articulation, and another at the distal extremity of the peduncle represents the inner flagellum.

The second pair of antennæ has the distal extremity of the scaphocerite furnished with more hairs, and a small tooth exists on the outer margin, defining the limit where cilia cease; the flagellum has increased in length, but to what extent is not determinable since it is broken in our specimen, in which it is subequal in length with half the carapace, and the peduncle is furnished at the base with a distinct phymacerite.

The two pairs of gnathopoda correspond with those of the previously described specimen, but differ in being armed with a sharp tooth on the inner distant angle of the basis, and another on the inner margin of the shaft, halfway between the coxal and basisal articulations; the presence of these teeth may be due to specific distinction rather than to progressive development, as well as the circumstance that the ecphysis and ischial joint each articulate at the extremity of an independent protuberance.

In this specimen the first pair of pereiopoda is present; it corresponds in form with the gnathopoda, but is not quite so large, and differs also in having no tooth on the inner margin near the middle of the basisal joint, while that at the inner distal angle exists; the absence of the former is suggestive of the relation of the teeth to the stage of development.

There is no evidence of the presence of the pleopoda in this stage, excepting the posterior or sixth pair, which helps to form part of the rhipidura. It consists of a short basal joint supporting two unequal foliaceous rami, the inner of which is the smaller, being scarcely more than half the length of the outer; it is lanceolate in form and fringed with hairs; the outer is broader, armed on the outer margin with a strong tooth, and on the inner and distal margin with hairs.

Another specimen (Pl. CXLVI. fig. 4) was taken north of New Guinea. It is about the same size as the last, 8 mm., but differs from it in having the first pair of pereiopoda with a long and sharp tooth on the middle of the basisal joint, and in having the fourth pair of appendages—the second pair of pereiopoda—present in an incipient condition.

This new pair is not, like the preceding one, a free appendage, but is enclosed within the dermal tissue each in the form of a long, narrow, and slightly constricted sac, compressed against the ventral surface of the pereion and directed forwards between the preceding pairs.

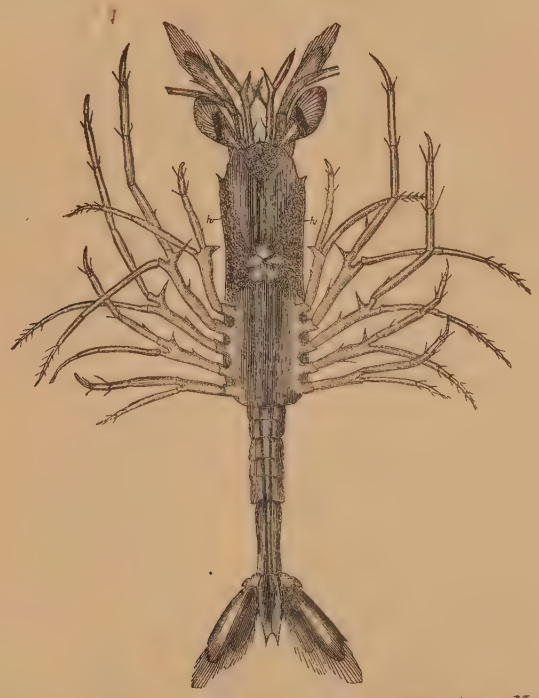

FIG. 75.—"From the north coast of New Guinea, Feby. 1875. Five-legged larva stage. Maxillipeds omitted; *h*, *h*, liver first visible; ventral aspect. Nat. size 12 mm. H. ¼." From a drawing by Dr. von Willemoes Suhm. Reduced one-half.

Another specimen (Pl. CXLVI. fig. 5), which was taken at the surface in the Atlantic, off St. Vincent, Cape Verde Islands, on April 6, 1873, is 9 mm. long, and corresponds very closely with that of fig. 4, but the second pair of pereiopoda exists as a free pendulous organ, although in a saccular condition, in the form of a stalk with two branches, which lie inwards and are directed forwards.

In this Atlantic specimen the small rostral point at the anterior extremity of the carapace, that is common to all the Pacific specimens, is wanting; it probably therefore is the young of *Amphion provocatoris*.

It may be noticed that this specimen also differs in having no tooth on the outer

margin of the scaphocerite, as there is in fig. 3, but corresponds in this part more nearly with that shown in the younger form of figs. 1 and 4.

In fig. 4 a tooth is shown as standing on the basis of the third appendage; it ought however to be mentioned that this tooth is absent from the leg upon the opposite side of the animal in the same pair.

The next specimen that marks an advance in development is one from the Pacific, in which four pairs of appendages—two gnathopoda and two pereiopoda—are well developed. It is 10·5 mm. (0·4 in.) in length, and, as in all the Pacific specimens, the small rostral tooth is visible in the centre of the frontal margin. The rest of the animal corresponds in most of its details with the forms described later, excepting that the telson has lost its foliaceous character and become more robust, it tapers to the extremity, and terminates in two small points as shown in Pl. CXLVII. fig. 1z.

In the month of February 1875, between the Philippine Islands and New Guinea, a specimen (fig. 75) was taken which has five pairs of appendages attached. It is 11 mm. (0·4 in.) long. The appendages are all developed on the same typical plan as in the preceding specimen; the small rostral tooth is present, and the only change beyond the addition of a pair of pereiopoda is that the telson has sent out at each point at its extremity two long and slender teeth.

Amphion reynaudii, Milne-Edwards (Pl. CXLVII. figs. 1, 2).

Amphion Reinaudii, Milne-Edwards, Ann. Soc. Entom. France, tom. i. p. 336, pl. xii. figs. 1–10, 1832.

„ *Reynaudii*, Milne-Edwards, Hist. Nat. Crust., tom. ii. p. 489, pl. xviii. figs. 8, 9, 1837.

This species was founded upon a specimen taken by M. Reynaud at the surface (*en haute mer*) of the Indian Ocean, and described and figured by Professor Milne-Edwards in the works above quoted. It was about one inch in length, and corresponds closely with the Challenger specimens, which approach it in size, and in the number of the pereiopoda, but it appears to be a little more advanced in development, more especially in the condition of the pleopoda, which are present in the form of biramose hairless buds.

The Challenger specimens have six well-developed pairs of appendages attached to the pereion, and like all the specimens taken in the Pacific, have a small rostral tooth attached to the frontal margin of the carapace, but which is hidden in the figure by the projection of the metope. In Milne-Edwards' figures this rostral tooth is not shown, probably owing to its concealment by the metope, or perhaps from the specimen having been examined with only a low power.

In our specimens the frontal margin of the carapace is slightly waved in a line across from side to side, with a minute rostral tooth in the median line; it is continued on each

side to a small, sharp, anteriorly directed tooth that stands upon the outside of the second pair of antennæ, whence the margin recedes obliquely backwards and outwards until it reaches a sharp anteriorly directed tooth of larger proportions, that corresponds with half the distance between the frontal margin and the oral apparatus; from the outer lateral tooth the carapace continues posteriorly to the extremity of the pereion, to which it gradually narrows.

The pleon consists of six somites and the telson. The pleopoda in our best-preserved specimen are visible only as incipient buds, with the exception of the posterior pair, which exists in a well-advanced condition and takes its character as part of the rhipidura of the adult animal.

The telson is long, tapering, and terminates in two small teeth, which converge distally.

Length, entire,	15	mm. (0·6 in.).
,, of carapace,	8	,,
,, of pleon,	7	,,
,, of third somite of pleon,	0·5	,,
,, of sixth somite of pleon,	2	,,
,, of telson,	1·5	,,

Habitat.—Pacific Ocean.

The ophthalmopoda are large, pyriform, and projected on a slender cylindrical pedicle, and pass on each side considerably beyond the lateral margin of the carapace. The ophthalmus is equal in diameter to twice the broadest part of the pedicle, which originates, one on each side of the great cephalic neural mass, in the centre of which on the dorsal surface is a small black pigmented eye.

The first pair of antennæ consists of a peduncle and two short flagella; the peduncle is only single-jointed, but at a short distance from the extremity there is a notch and a small hair, and beyond it another small hair, each suggesting the point at which the future articulations will occur. The flagella are subequal in length and very nearly equal in diameter; they are both smooth and free from hair, but the outer supports two short spines situated close together near the apex.

The second pair of antennæ has the two basal joints of the peduncle broad, the second distally supporting a long scaphocerite that is narrow at the base, distally broad, rounded at the extremity, the margin of which is fringed with long cilia, and the outer margin is armed with a long and slender tooth. Beyond the second joint I can recognise but a single robust joint that supports the slender flagellum, which appears to be long but is broken off at about the length of the scaphocerite. In Milne-Edwards' figure it is represented as entire and about half the length of the carapace.

About one-third of the distance between the frontal margin and the first pair of gnathopoda stands the epistoma, and posterior to it on each side are the mandibles, and

behind them near together stand the three pairs of siagnopoda. These are all distinctly visible in Dr. von Willemoes Suhm's mounted specimens, but finding in the collection one preserved in spirits, that was taken in the Pacific near Fiji, I took advantage of the circumstance to dissect out separately each oral member, and have figured them in the plate (*d*, *e*, *f*, *g*).

The mandibles (fig. 1*d*) are simple, having an apophysis, but neither molar process nor synaphipod; the psalistoma is sharp-pointed and serrate.

The first pair of siagnopoda (fig. 1*e*) is three-jointed; the first two joints are broad and foliaceous, and tipped with hairs on the inner margin; the third is cylindrical, short, and tipped with three or four hairs. Milne-Edwards says that the first pair is nearly rudimentary and appears to consist of a small horny scale bordered with cilia. It appears to me, on looking at the figures given by Milne-Edwards, that in his dissection he has broken the appendage in two, and that his figures 6 and 7 put together will, when combined, correspond with my figure (fig. 1*e*), which agrees with the representation of the same appendage given by Anton Dohrn.[1]

The second pair of siagnopoda (fig. 1*f*) is three-jointed; the central joint is bilobed, and each is fringed with a cilium on the inner surface; on the outer side is a broad, oval, foliaceous plate that is fringed with hairs radiating centrifugally round the margin, and is the homotype of the mastigobranchial plate of the higher groups of Macrura. This corresponds with Milne-Edwards' third pair, and with the second maxillæ in Anton Dohrn's description. Claus[2] figures this appendage, representing the three internal lobes much as they are given in my figure (fig. 1*f*), but he represents the outer foliaceous plate as being comparatively small and sparsely fringed with distant cilia; it should be remembered, however, that Claus drew his figure from an older specimen, since he represents it with a seventh pair of pereionic appendages in a rudimentary form.

The third pair of siagnopoda (fig. 1*g*) consists on the inner side of a four-jointed appendage, of which the first or basal joint is broad, foliaceous, and fringed with hairs; the second, third, and fourth joints are narrow, cylindrical, and distally carry a single hair on the inner margin; at the base of the first joint on the outer side is a long and slender biarticulate rod, furnished with cilia at the distal extremity; at the base of this rod there is a large ovate plate, the margin of which is fringed with distant cilia, and near its base stands also a short membranous plate. The inner four-jointed branch I believe to be the representative of as many joints of the typical leg, the outer rod being the basecphysis, while the two foliaceous plates represent the mastigobranchia and the rudiment of a branchial appendage in its saccular form. Milne-Edwards' figure corresponds with mine in part only, omitting the two outer plates, which also correspond

[1] Untersuchungen über Bau und Entwicklung der Arthropoden, taf. xv. fig. 3, Leipzig, 1870.
[2] Crustaceen-Systems, p. 48, taf. viii. fig. 9, 1876.

with the figures given by Anton Dohrn [1] and also that figured by Claus,[2] but each of these authors shows that the external rod is only a branch of the basal joint, which is I presume the second or basisal joint, and neither gives the outer foliaceous branch, although Anton Dohrn shows the rudiment of such, unless it be the fragment of a ruptured appendage, and he moreover figures what I believe to be a basecphysis with four small terminal articulations. Claus represents the same organ as being multiarticulate for two-thirds of the entire length, whereas Milne-Edwards figures it as being uniarticulate, which corresponds more nearly with my own observation, since, although I saw indications of there being three, the articulations appear not to have been fully formed, but only defined by the presence of marginal cilia.

The six pairs of pereionic appendages represent the two pairs of gnathopoda and four pairs of pereiopoda; these all correspond in general form, but differ a little in size and ornamentation, they are all six-jointed and have a long basisal joint, which carries a long multiarticulate ecphysis attached to the distal extremity. All, excepting the first gnathopod and the posterior pereiopod, are furnished with a strong tooth near the middle of the basisal joint, as well as with one on the anterior distal angle of all except the posterior pair, and with three or four others on the next succeeding joint (ischium) in all except the first and last pairs of appendages. Now, these tooth-like prominences are too numerous and conspicuous to be overlooked, and since they are not shown by Milne-Edwards on the basis in either of his figures, while he shows them on the ischial joints of all excepting the first and last pairs in his figure in the first-quoted work, and as Claus represents his species as having the appendages smooth throughout, excepting the second pair of gnathopoda, which is armed with a strong tooth on the anterior distal angle of the basis and one on the anterior margin of the ischium of the same pair, I am inclined to believe that it is possible there may be a greater amount of specific separation between the several specimens observed than has generally been supposed, although the instances of variation in what I believe to be specimens of the same species induce me to hesitate until further opportunity may decide.

The branchiæ (fig. 1*br*) are now beginning to make their appearance in the form of small plumes within sacs attached to the coxa of the second pair of gnathopoda and the first pair of pereiopoda.

The pleopoda are also becoming visible as incipient buds; there is a pair at the postero-lateral angles of each somite excepting the first; that on the sixth somite being already in a well-advanced condition and taking its character as a permanent part of the rhipidura of the adult animal.

In the Western Pacific, north of New Guinea, three other specimens were obtained that are 25 mm. in length. One of these was labelled by Dr. von Willemoes Suhm

[1] *Loc. cit.*, pl. xv. fig. 5.

[2] *Loc. cit.*, pl. viii. fig. 10.

"Amphion Adult"; but this can scarcely be an adult seeing that it has only six pairs of appendages attached to the pereion; in these the branchiæ are present in a more or less advanced condition, existing as a single plume corresponding with each pair of appendages excepting the first gnathopoda; the plumes are attached near the middle to the pleural surface of the pereion, and taper gradually to each extremity.

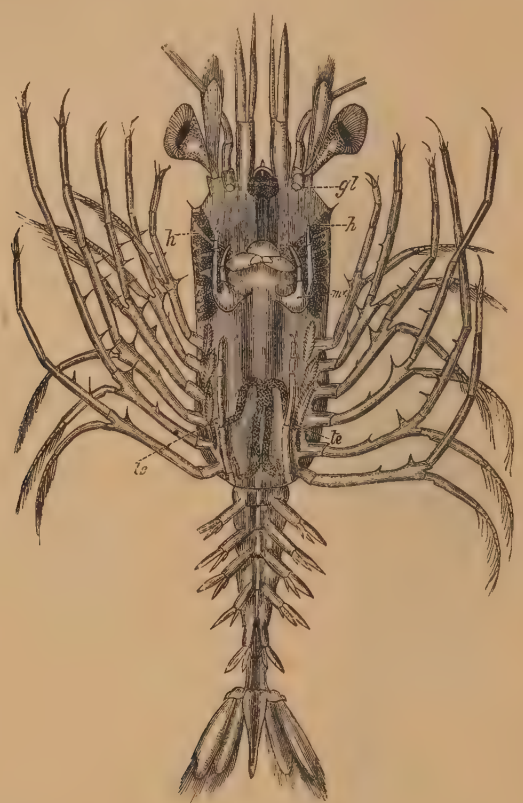

FIG. 76.—*Amphion* with seven legs, and five pairs of branchiæ; *gl*, gland; *h*, *h*, liver; *mx*, maxilla; *te*, *te*, testes. Reduced a half from Suhm's drawing.

Their structure (fig. 2*br*) is that of a series of thin foliaceous plates resembling those of the Phyllobranchiata, forming one broad plate on either side of a central stalk.

The next specimen (fig. 76) is the most advanced that has yet been observed; it was taken with the preceding on the northern side of New Guinea, and was drawn while yet in a fresh state by Willemoes Suhm, but whether it be the same as that which is given on Pl. CXLVII. fig. 2, I am not certain, but I believe that it is, and if so the posterior pair of pereiopoda is represented much too long by Suhm.

He supposed it to be a male, but he figures the anterior pair of pleopoda as biramose, which does not correspond with my observation as to the permanent character of this appendage in the male.

Length, entire,	25	mm. (1 in.).
„ of carapace,	16	„
„ of pleon,	9	„
„ of third somite of pleon,	1·5	„
„ of sixth somite of pleon,	2	„
„ of telson,	2·5	„

This specimen retains all the features described in previous specimens, but it has in addition a seventh pair of pereionic appendages, that only differs from Suhm's figure in being shorter, but it is considerably longer and in a more developed condition than that represented in Claus' figure of a similar stage. These appendages, as seen in fig. 2*o*—the fifth pair of pereiopoda,—differ from all the preceding in being smaller, and in not having an ecphysis attached to the basisal joint; moreover, they appear to be seven-jointed, whereas all the preceding legs consist of six joints only. It has a branchial plume similar to those belonging to the other pereiopoda, but smaller, and like them attached to the lateral walls of the pereion rather than to the coxal joint, they are therefore pleurobranchiæ, and may be tabulated as follows :—

	h	i	k	l	m	n	o
Pleurobranchiæ,	...	1	1	1	1	1	1
Arthrobranchiæ,	...	...	...	...	...	...	...
Podobranchiæ,	...	...	...	...	...	...	...
Mastigobranchiæ,	...	...	...	...	...	...	...

The pleopoda now appear as biramose appendages, of which both stalk and branches are short and flat, but as yet they are not fringed with hairs, the inner ramus has a stylamblys attached to each successive pair, excepting the posterior, which forms the lateral plates of the rhipidura and is fringed with long hairs.

The telson is tapering and terminates in two small teeth that approach each other at their apices.

The ophthalmopoda are less elongated, and the first pair of antennæ has the flagella a little more tapering, but the peduncle is not more distinctly articulated, while the second pair is apparently not advanced from those seen in fig. 2.

The nervous system appears to be more concentrated, the central ganglia being in a firmer condition, each group consisting of two ganglia, separate from each other from the second gnathopod to the fourth and probably the fifth pair of pereiopoda.

The oral appendages, closely packed together and well developed, stand halfway between the frontal margin and the first pair of gnathopoda.

On each side of the œsophagus is a series of arborescent hepatic vesicles.

On each side of the central neural cord is a series of saccular bodies (*te*) that I take to be the testes, these increase in size but suddenly disappear about the level of the second pair of gnathopoda. Corresponding with the first pair of pereiopoda Suhm has figured two symmetrical convoluted tubes that he considers and labels testes (fig. 76, *te*), and figures them as passing to the coxal joint of the posterior pair of pereiopoda.

It is probable that when Suhm examined the animal it was in a state better adapted for observation than it is at present, after having been preserved in Canada balsam for some time. The remains of these tube-like vessels still exist, but they are disrupted and not symmetrically continuous in the specimen from which I have taken my drawing, one side being more perfect than the other, but neither of them was continuous to the posterior pair of pereiopoda, as shown in Suhm's figure. Assuming that they are portions of the tubular structure figured by Suhm, I am inclined to think that they are the spermatic ducts that, when perfect, are continuous with the testes shown at the anterior portion of the pereion.

The nervous system is fairly shown in several specimens in the collection, and especially in Pl. CXLVII. fig. 2. The cephalic ganglion, or rather mass of ganglia, appears to be of a more concentrated and solid character than in other younger specimens, and the ocellus is reduced to a small point situated above the anterior portion; from this mass neural threads are seen to pass to the ophthalmopoda and the first and second antennæ; from the posterior margin two cords arise, one on each side of the median line, and pass round and meet behind the œsophagus, where there are three or four ganglia[1] situated in close succession and connected by short double cords and surrounded by a mass of neural tissue sending off nerve threads to the mandibles and siagnopoda; from the posterior of these ganglia, the two cords proceed, lying close together so as to appear but one, until between the first pair of gnathopoda, where they appear to swell out in the form of an elongated ganglion, and on each side, as in the preceding, nerve threads are sent off to the lateral appendages; in this as in the others these threads do not spring from the central ganglion but from a surrounding mass of neural cell tissue. From the ganglion between the first pair of gnathopoda the central nerve-cords pass as one in the median line between the second pair of gnathopoda, where there are two distinct ganglia surrounded by a mass of neural cells, that supply nerve branches to the lateral appendages; from these ganglia the central cord proceeds as two separate threads to two ganglia situated between the first, second, third, and fourth pairs of pereiopoda, beyond which I was not able to determine them, although traces of other ganglia are apparent between the posterior pair of appendages.

[1] These ganglia I ought to have drawn a little further forward.

Amphion provocatoris, n. sp. (Pl. CXLVIII.).

On the 7th of May 1876, in the Atlantic, south of the Azores, the largest and apparently most mature specimen in the collection was taken. It differs from all the larger specimens that were taken in the Pacific, by having no rostral tooth on the frontal margin of the carapace, by having the fronto-lateral angles anteriorly produced to large dimensions, and in having a tooth on the dorsal surface corresponding with the gastric region.

The carapace is long, narrow, and decreases slightly towards the posterior extremity, it is half as long again as the pleon, including the telson, which equals the length of the sixth somite.

Length, entire,	. . . . .	27 mm. (1·1 in.).
„ of carapace,	. . . . .	15 „
„ of pleon,	. . . . .	12 „
„ of third somite of pleon,	. . . .	1 „
„ of sixth somite of pleon,	. . . .	2 „
„ of telson,	. . . . .	3 „

The dorsal surface of the carapace has the frontal margin nearly straight, and shows a minute ocellus in the median line, behind which, halfway between the epistoma and the frontal margin, stands a laterally compressed, dorsally erect and anteriorly pointed, well-developed tooth. On the outer angle of the frontal margin stands an anteriorly directed tooth that forms the inner canthus of the orbit, which exists on the outer side in the form of a small emargination, the outer angle of which is rounded, beyond which the margin slopes gradually to the fronto-lateral angle, which is defined by a strong tooth, from which point the dorso-lateral margin, with a slight curve gradually narrows to the posterior extremity of the pereion. The infero-lateral margin from the latero-frontal tooth curves inwards and downwards just behind the oral appendages, and then recedes upwards and backwards in a line corresponding with the dorso-lateral margin of the carapace.

The pleon is narrow and gradually tapers to the extremity of the telson, which under a high power is seen to divide into two small points, but which in the typical specimen appears to be considerably worn down. The five anterior somites of the pleon are short, while the sixth is as long as the preceding two, and the telson is subequal with the sixth.

The ophthalmopoda are short and do not reach beyond the lateral margins of the carapace; they are pyriform and supported on a slender but short pedicle that appears to articulate with its own wide somite just beneath the frontal margin of the carapace. The ophthalmus is long-ovate.

The first pair of antennæ has the peduncle broader at the base than at the distal extremity and appears to be uniarticulate; it carries at its extremity two flagella, the

inner of which appears to be a little more robust than the outer, which however is slightly longer and furnished with one or two hairs near the distal extremity.

The second pair of antennæ has the first two joints short and robust, the first joint being implanted beneath the carapace considerably posterior to the frontal margin, and in which Suhm observed the green gland to be present; the second joint at the outer angle supports a large scaphocerite that is slender at the base and broad at the distal extremity, which is rounded, fringed with hairs, and armed on the outer margin with a strong tooth. On the inner angle of the second joint stands the third and terminal joint of the peduncle, at the extremity of which there is a slender multiarticulate flagellum, which is broken off at about half the length of the carapace; each articulus being armed with a small point.

The oral appendages I have not dissected out, but *in situ* they appear under careful observation to correspond generically with those already described.

The first pair of gnathopoda is situated posteriorly to the oral appendages, subequally with the distance of the latter from the frontal margin; it resembles the other appendages but has the shaft of the basis smooth and is not quite so large.

The second pair of gnathopoda, as well as all the pereiopoda, is armed with a sharp and long tooth near the middle of the basisal shaft and another at the anterior extremity of its distal angle; there are several on the ischium of all the pereiopoda. The posterior pair is rather smaller and less armed with teeth. The seventh appendage or the fifth pair of pereiopoda is not present, nor can I see any trace of it, although in other respects the animal appears as far advanced as the specimens of *Amphion reynaudii*.

The first pair of pleopoda (*p*) is developed as a long cylindrical, slightly curved, uniarticulate rod, the extremity of which is rounded.

The second (*q*) and following pairs resemble each other; these are short and consist of a peduncle that is broad and supports two branches which are subequal in length with the basal joint, the inner is a little shorter than the outer and supports a small and in this stage rudimentary stylamblys.

The posterior pair of pleopoda forms part of the rhipidura; the outer plate is broader and longer than the inner, the distal and inner margins are fringed with long hairs and the outer margin is slightly serrate near the distal extremity, where it is also armed with a strong tooth.

The telson is long, slender, and tapers to a point, the extremity of which appears to be minutely forked, the points of which in our specimen being worn.

The internal structure is not so well preserved or so plainly marked as in some of the other specimens, but a mass of cellular tissue corresponds with that which in *Amphion reynaudii* I have thought to be the testes, but which in this specimen vary somewhat in appearance, which I believe may be attributed to the manner of its preservation.

The brephalos of *Amphion* has not yet been observed, and the form hitherto known

as the earliest is that which was described and figured by Anton Dohrn in his memoir on *Amphion reynaudi*.[1] This he calls the Zoea form, and specimens which he procured from the Hamburg Museum were 7 mm. in length.

The specimen that I have figured (Pl. CXLVI. fig. 1) I believe to have been the same as that which is given in fig. 73 (p. 903), from a drawing by Willemoes Suhm, and examined by him while in a fresh condition. It was only 5 mm. long, and we may assume it to be a younger animal than that which Dohrn has described.

In this stage, the earliest yet known, the cephalic appendages are all in a forward condition, the oral appendages in a mature form, and the two pairs of gnathopoda fully developed as far as they are yet known to be. The pleon consists of only six somites, and the caudal extremity is a simple spoon-like foliaceous plate, fringed with a few hairs.

Fig. 2z in the same plate represents the caudal extremity of another specimen that has attained the length of 6 mm., in which no degree of progressive growth is observable, excepting that the sixth pair of pereiopoda is seen to be taking form within the integumental structure, but is not yet developed as a free appendage. Dohrn's specimen is 7 mm. long, and at this stage as shown by him,[2] the first pair of pereiopoda or third pair of appendages are in the course of development in the form of a pair of curved saccular appendages, and the caudal extremity has undergone a great change in the development of the sixth pair of pleopoda as the lateral appendages of the rhipidura, while the telson still retains the broad and foliaceous condition of the earlier known Zoea stage.

Fig. 3 in Pl. CXLVI. represents a specimen that has progressed a little further, and shows the third pair of appendages or first pair of pereiopoda developed; the rhipidura is more advanced by the telson being produced in a narrow and tapering form instead of being broad and foliaceous as in Dohrn's specimen.

On Pl. CXLVI. fig. 4, one is seen to have the second pair of pereiopoda (*l*) or fourth pair of appendages in an early stage of development, in the saccular stage, while in fig. 5 on the same plate the same pair of appendages is shown in a still more advanced form, being biramose and saccular. The rhipidura is increasing in the adult characters, but as yet the telson though broad is reduced to a tapering and foliaceous condition.

One specimen, 11 mm. long, was taken in the Western Pacific, in which the four pairs of legs are fully developed, but I have not thought it necessary to figure it because it so closely resembled fig. 1 on Pl. CXLVII., except for the presence in the latter of two more pairs of legs.

One specimen with five well-developed pairs of legs was taken in the West Pacific

[1] *Loc. cit.*, pl. xvi. fig. 11.

[2] *Loc. cit.*, p. 174, pl. xvi. fig. 10.

in February 1875; it is 11 mm. long, and corresponds so closely with *Amphion reynaudii* as shown on Pl. CXLVII. fig. 1, with the exception that it has only five pairs of legs, that I thought it unnecessary to figure it beyond showing the frontal margin of the carapace with the cephalic appendages (Pl. CXLVI. fig. 6), which viewed from the dorsal surface are more distinctly shown than in any of the previous specimens.

A specimen in this collection, which is given on Pl. CXLVII. fig. 2, corresponds so closely with *Amphion reynaudii* of Milne-Edwards, that I have so named it; I have figured it with the greatest care, but the internal viscera are not in a well-preserved state, the structure having been injured probably by being mounted in Canada balsam. The cephalic and oral appendages are visible, as well as the hepatic organs and two pairs of branchiæ in an immature condition, corresponding with the pleura above the second pair of gnathopoda and first pair of pereiopoda. This form is so little advanced towards maturity that with the exception of the sixth pair of pleopoda, which forms part of the rhipidura, no appendage of the pleon has advanced beyond the most incipient stage of budding.

The first somite of the pleon showing no trace of an appendage appears to me evidence of its being a female, an idea that is supported by the presence of nucleated hexagonal cells, a mass of which in a broken condition is retained on one side of the median line, between the first and second pairs of perciopoda; this specimen is only 15 mm. long, whereas the two others show evidences of the male character, and these are 25 mm. long.

Two others with six pairs of legs were taken in the Atlantic on the homeward voyage; one in March, the other in May, 1876. Of them I have taken the latter as the type of a new species, the chief characteristics of which are a tooth on the dorsal surface of the carapace and the form of the frontal margin of the carapace, which is without a tooth in the median line, and has an excavation corresponding with the orbit, and in this specimen the first pair of pleopoda is developed into a cylindrical uniarticulate rod, a feature that I believe to be characteristic of the male animal rather than a specific character, for with a slightly different formation it exists in a specimen found in the West Pacific Ocean, and which in several respects corresponds with this species from the Atlantic, among which I think may be seen a prominence like a tooth rubbed down, on the dorsal surface of the carapace between the gastric region and the frontal margin.

Among those taken in the West Pacific Ocean, north of New Guinea, there was a specimen that I have represented in fig. 2 on Pl. CXLVII. Willemoes Suhm has figured this same specimen I believe in fig. 76. This animal is well advanced towards maturity and is fully described at page 910. In Suhm's drawing, the

posterior pair of pereiopoda is sufficiently long to be able to reach as far as the first pair of gnathopoda, in mine it does not quite reach to the base of the second pair of pereiopoda, and is feeble and very slender. Claus [1] figures this stage, but represents the ultimate pair of legs as being still more feeble than those in the Challenger specimen. And Anton Dohrn [2] figures the pereion with an indication of the position of the second appendage in relation to the nervous system, and shows that the posterior pair is of scarcely less importance than the penultimate or fourth pair of pereiopoda, and is connected with an independent ganglion subequal in size with that of any of the preceding pairs.

This appears to me to demonstrate that the developmental process is of a more constant growth than is the case in other forms of Macrura.

Among all the specimens that have been obtained there is not one that can yet with certainty be pronounced to be adult. Yet it is difficult to suppose that from the numbers of animals that have been traced through a consecutive series of stages, from those with two pair of legs up to those with seven—the normal number that exists in the Decapod Crustacea—that any very decided external change can take place at the putting on of the adult features, which appear to consist in having only the several appendages of the pleon fringed with hairs.

To Anton Dohrn is due the credit of showing the true relations of the Zoea forms to the adult *Amphion*, and we cannot but admire the candour of Claus, who, after carefully investigating Anton Dohrn's observations and arriving at a distinctly different conclusion, has wound up his Crustaceen-System by the following "Supplementary Remarks."

"After the printing of this work was completed I became acquainted with the communication concerning the development of some Palæozoic Decapoda by R. v. Willemoes Suhm in the February number of the Annals and Magazine of Natural History.

"This contains some interesting notes about the genera *Amphion*, *Sergestes*, and *Leucifer*, which, had I been acquainted with them earlier, would have induced me to have taken a rather different view in the chapter on *Amphion*.

"It is true that my criticism of Dohrn's interpretation of *Amphion* as an adult animal is in nowise thereby invalidated, and what I have said of the insufficiency of the rudimentary branchiæ, of the absence of a fringe of hair to the pleopoda, as well as of the termination of the supposed ovaries on the posterior pair of pereiopoda (concerning the size and form of which we have heard nothing from Dohrn) as proofs of the sexual maturity of *Amphion* remains unimpeached, as does also the larval nature of the Crustacean described by M. Milne-Edwards under the name of *Amphion* and characterised by six pairs of divided feet.

"Willemoes Suhm has expressly stated that he had found among three full-grown *Amphions* two male individuals, but probably it was in consequence of the

[1] *Loc. cit.*, pl. viii. fig. 8, Fs.

[2] *Loc. cit.* pl. xv. fig. 2. xii.

development of the seventh pair of appendages without much change in the form of the animal that he was induced to believe in its adult condition.

"The form of the antennæ, and of the seventh pair of legs, the structure of the branchiæ, of the appendages of the pleon, and of the sexual apparatus must be more fully known before the question of the adult condition of the animal can be looked upon as decided. Under all the circumstances I was justified in considering as larval forms the largest specimens with which I was acquainted, and which possess the seventh pair of appendages in a rudimentary condition, rudimentary branchiæ, and the pleopoda without hairs, in accordance with Dohrn's description, and also in prostesting against interpreting as an ovary the mass of cells with its opening, on the basis of the description and figure of the last-mentioned author.[1] If *Amphion* in an unchanged form really becomes an adult animal, we have in it a new and interesting form of Schizopod, in which the maxillæ and gnathopoda (vorderen Kieferfüsse)—as is also the case in *Petalophthalmus* and *Chalaraspis*—indicate a transition to the Decapoda, and in which the carapace already overlaps all the pereionic somites."

The view that these several forms of *Amphion* suggest, is that from the brephalos to the adult animal the development is regular with the growth of parts, but that as yet we have not obtained the earliest nor reached the latest stage of growth. What the latter stage may be can only be surmised, but I believe it cannot be very distinct in its external characteristics from that of the oldest known specimen of *Amphion*. The form and nature of the branchial plumes demonstrate that it belongs to a family of the Phyllobranchiata that is parallel with the Synaxidea in its relation to the Trichobranchiata, and which it approaches in the form and character of its appendages, with the exception of its having a scaphocerite attached by the second pair of antennæ, which the Synaxidea have not.

[1] Dohrn, *loc. cit.*, pl. xv. figs. 1, 2.

APPENDIX A.

DESCRIPTION of SYLON CHALLENGERI, n. sp., a Parasitic Cirriped. By Dr. P. P. C. HOEK, Member of the Royal Academy of Sciences of the Netherlands.

IN May 1886 Mr. C. Spence Bate sent me a specimen that looked like a *Sacculina*, the only one that he ever saw of the kind attached to a Macrurous Crustacean.

The Macruran to which it was attached was a specimen of *Spirontocaris spinus* (Sowerby), var ϵ. It was taken during the voyage of the Challenger at Station 49, off Halifax. It is figured on Pl. CVI. fig. 5ϵ, of Mr. Spence Bate's Report, being shown *in situ;* in fig. 10 of the same plate it is shown isolated. In the explanation of this plate it is referred to as a saccular parasite.

At the suggestion of Mr. Spence Bate, Mr. John Murray, Director of the Challenger Commission, asked me to describe the specimen in order to have a description of it embodied in Mr. Spence Bate's Report, a request which I gladly accepted.

The reason Mr. Bate proposed to send the parasite in question to me, was that he believed it to be a parasitical Cirriped. After careful examination, I am able to confirm Mr. Spence Bate's provisional determination; for I found that it belonged to a genus of the Rhizocephala, or parasitical Cirripedia, *Sylon*, a genus well known to the Norwegian zoologists, but no specimens of it had been previously taken in the Atlantic south of lat. 60° N.

Before proceeding to describe the specimen, it will be well to say something concerning the literature of the genus.

In 1855 H. Kröyer[1] published a short note on a very insufficiently known group of Crustaceans, *Pachybdella* and its congeners. This note is remarkable from a historical point of view, since for the first time a third genus of these lower Crustaceans, which afterwards were shown to form the group of the Rhizocephala, was spoken of. The two previously known genera are *Pachybdella*, Diesing (*Sacculina*, Thompson), and *Peltogaster*, Rathke. Of *Pachybdella*, the species of which inhabit Crabs, Kröyer mentions two species, and of *Peltogaster*, which occurs on the abdomen of *Pagurus*, five different

[1] H. Kröyer, Bemaerkninger om en meget ufuldstaendigt bekjendt Gruppe af Krebsdyr Pachybdella o.s.v., *Oversigt o. d. K. D. Vid. Selsk. Forhandl. Kjøbenhavn*, pp. 127–131, 1855.

species were known to him. Of the third genus, *Sylon*, Kröyer proposed only one species, though the different specimens show considerable variation in shape and size. It seems to occur on the genus *Hippolyte* only. No description of the genus *Sylon* is given in this note; and Kröyer's death in 1870 occurred before the paper, in which he intended to give a full description of the different species and genera, was published. With regard to *Sylon* the only things we learn from his note of 1855 are that its metamorphosis is much like that of *Pachybdella* and *Peltogaster*, and that he believes it to be the only genus of the group in which a kind of vascular system occurs.

In 1870 G. O. Sars published [1] the second part of his father's Bidrag til Kundskab om Christianiafjordens Fauna, with the aid of the manuscript left by his father, Dr. Michael Sars, who died in 1869. The same memoir was also published separately.[2]

In this paper a description is for the first time given (pp. 41–48) of the genus *Sylon*, Kröyer, and of two species belonging to it. The one is *Sylon hippolytes* (Kröyer), most probably the same species that Kröyer observed; it was found on the under side of the abdomen of *Hippolyte securifrons*, Norman, which was taken at a depth of 40 to 60 fathoms in Storemedet, and at a depth of 100 to 120 fathoms in the Rødtangdybet. M. Sars points out that the same species occurs attached to a specimen of *Hippolyte polaris*, Sabine, which Daniellsen obtained in Hardangarfjorden at a depth of 250 fathoms. The other species described is *Sylon pandali*, M. Sars, a parasite of *Pandalus brevirostris*, which lives at a depth of 25 to 60 fathoms "in freto Drøbachiensi." Both species are figured and a fairly full description is given, the only one hitherto published.

The diagnosis which M. Sars proposes for the genus *Sylon* is as follows:—

"Corpus sacciforme, ovatum, subteres, cute (pallio) pellucida sed firma vestitum. Os vel apertura suctoria in organo adfigendi acetabuliformi, annulo corneo cincto, in latere inferiore corporis situm, ubi in posteriore parte aperturæ (genitales) binæ parvæ circulares beantes, symetrice positæ, cavitatem intrapallialem aperientes, adsunt. Genitalia bisexualia: ovarium ramosum, in sacco magno maximam partem cavitatis interpallialis explente inclusum; testiculus parvus ovatus, in posteriore parte ventrali hujus cavitatis situs."

At the end of his description of the two species, Sars points out the differences existing between *Sylon* and the other known members of the family Peltogastridæ, established by Lilljeborg. *Sylon* differs from *Peltogaster* in not having an aperture at the anterior extremity of the body, and also in having only a single testis; from *Apeltes* it differs both by the absence of the anterior aperture and of the short tube at the hindermost extremity of the body, and by the presence of a well-developed organ for its attachment to the host, with a mouth in the centre. *Sylon* also differs from both by the shorter form of the body, in which respect it rather resembles *Clistosaccus* of

[1] *Nyt Mag. f. Naturvid.*, vol. xv.

[2] Christiania, Johan Dahl, 1870.

the Sacculinidæ, and especially by the presence of two symmetrically situated apertures (genital pores) at the ventral side, in the hindermost part of the body.

In consequence perhaps of its being in the Norwegian language, this paper of M. Sars has not become known so widely as it merited. Neither Kossmann[1] nor Delage,[2] both of whom give an extensive bibliography in their papers on the Rhizocephala, mentions the above paper of M. Sars.

In his second paper on the fauna of the Arctic fjords published in 1884, J. Sparre Schneider of Tromsø[3] gave an enumeration of the Crustaceans and Pycnogonids he collected in 1881 in the Kvænangsfjord. In this fjord *Hippolyte pusiola* is common at a depth of 5 to 10 fathoms, at the place where it communicates with the Sørfjord. Schneider says[4] that this species is to a considerable degree infested with parasites, viz., a species of *Sylon* peculiar to *Hippolyte pusiola*, a couple of them being often observed on the same individual.

In the same year Max Weber[5] published the results of his researches on the Isopods collected during the cruises of the "Willem Barents." Speaking of *Phryxus abdominalis* (Kröyer), Weber says[6] that along with the Isopoda of the Barents collection, a specimen of *Hippolyte incerta*, Buchholz, was handed to him, which was infested on the ventral surface by a parasite, that on superficial investigation might be taken for a Bopyrid. On closer examination this idea was given up, and on comparing the parasite in question with specimens of *Sylon* attached to *Hippolyte pusiola*, which he collected himself near Tromsø, he saw at once that the parasite of *Hippolyte incerta*, Buchholz, also belonged to the genus *Sylon*. Through the kindness of Professor Max Weber of Amsterdam University, I was enabled to investigate two specimens of this species of *Sylon*, attached to *Hippolyte pusiola*, Kröyer, and to compare them with the Challenger specimen obtained off Halifax. This comparison brought out the great resemblance between them. They may be different species, but they clearly both belong to the genus *Sylon*. Whether in every case two specimens of *Sylon* living on different hosts should be regarded as different species, I do not venture to decide. From the analogy of similar cases of parasitical Isopoda, great prudence is certainly necessary in coming to a conclusion.

[1] Kossmann (Beiträge zur Anatomie der schmarotzenden Rankenfüssler, p. 5, 1874), says with regard to *Sylon*:—"Der Genusname *Sylon*, welchen zu characterisiren Kröyer durch den Tod gehindert wurde, kann füglich aus unserer Literatur wieder verschwinden, zumal K. seine Exemplare, wie er selbst angibt, sämmtlich verarbeitet hat."

[2] Delage (Evolution de la Sacculine, *Archives d. Zool. expér.* (2), tom. ii. p. 424, 1884), in regard to *Sylon* is also very decided:—"La même année (1855) Kröyer ajoute aux deux genres déjà connus le genre *Sylon*. Mais il omet de le caractériser et de conserver un exemplaire. Personne depuis n'a pu retrouver le *Sylon*, en sorte que c'est là un genre, que sauf Kröyer, personne n'a vu, et dont personne ne connaît les caractères. Le retrouvera-t-on ?"

[3] J. Sparre Schneider, Undersøgelser af dyrelivet i de Arktiske fjorde, II. Crustacea og Pycnogonida indsamlede i Kvænangsfjorden, 1881, *Tromsø Museums Aarshefter*, vii., 1884.

[4] *Loc. cit.*, p. 52.

[5] Max Weber, Die Isopoden gesammelt während der Fahrten des "Willem Barents" in das Nördliche Eismeer in den Jahren 1880 und 1881, *Bijdragen tot de Dierkunde*, 1884.

[6] *Loc. cit.*, p. 34.

The following list gives the different cases in which species of *Sylon* have hitherto been observed :—

Parasite.	Name of Host.	Observer.
Sylon hippolytes (Kröyer),	*Hippolyte securifrons*, Norman, .	M. Sars.
„ „	„ *polaris*, Sabine, . .	„
„ *pandali*, . .	*Pandalus brevirostris*, Rathke, .	„
„ *schneideri*, n. sp., .	*Hippolyte pusiola*, Kröyer, .	Sparre Schneider, Max Weber, Hoek.
„ sp., . . .	„ *incerta*, Buchholz, .	Max Weber.
„ *challengeri*, n. sp., .	*Spirontocaris spinus* (Sowerby), .	Hoek.

The specimen of *Spirontocaris spinus* on which the parasite was found had a length of 37 mm. It was attached to the third segment of the abdomen. According to M. Sars, *Sylon hippolytes* is also attached to the third, and *Sylon pandali* to the first abdominal segment of its host. According to my own observations, *Hippolyte pusiola* likewise bears its *Sylon* on the third segment of the abdomen.

In the case of *Spirontocaris spinus*, as shown in Pl. CXLIX. fig. 1, the parasite is attached by a considerable part of its surface, the attached part being circular and having a diameter about half as long as the longest axis of the parasite. The body-wall of the shrimp and of the *Sylon* almost imperceptibly pass into one another; when separating the parasite its chitinous covering was found to have a yellow-coloured thickening, of the shape of a ring, round the place of attachment.

The shape of the parasite is oval,[1] its long axis running nearly but not quite parallel with that of the Shrimp. If we apply the term poles to the extremities of the longest axis, then the anterior pole is situated at a somewhat greater distance from the ring of attachment than the posterior pole. In the species of *Sylon* found upon *Hippolyte pusiola*, and which I will call *Sylon schneideri*, not only is the greater part of the body of the parasite situated in front of the base of attachment, but the anterior pole is at a considerably greater distance from the surface of the host than the posterior pole. The greatest diameter of *Sylon challengeri* measured about 4 mm., and the two other axes only measured 3·16 and 2·6 mm. Taking the plane of the two other axes as perpendicular to the direction of the longest axis, the one second in length (3·16 mm.) is perpendicular, or nearly so, to the surface of the Shrimp; the shortest of the three is the one that runs from the right to the left side of the body of the parasite.

[1] The figures of the parasite on Pl. CVI. figs. 5*e*, 10, represent it as spherical; but this is not quite exact. Fig. 10 also shows the parasite as being attached by means of a short but distinct peduncle, but this is not the case.

Sylon hippolytes, M. Sars, is 10 mm. in length and 7 in breadth; *Sylon schneideri* had a very different size in the specimens I was able to investigate; in one the dimensions were about 3·1 by 2·1 mm., in another the length and the greatest breadth measured 6 and 4·1 mm. respectively. I have also seen a specimen of *Hippolyte pusiola* with *two* small specimens of *Sylon schneideri* attached to it; the one about 1·5, and the other 2 mm. in length.

The specimen of *Sylon challengeri* which was sent me was not quite uninjured. As is shown in figs. 1 and 3, Pl. CXLIX., the outer wall of the body was torn open in front, and this damage, caused perhaps by the desire of the artist to see as much as possible of the animal without detaching it from the *Spirontocaris*, at first caused some difficulty in the determination of the animal. In *Sylon* the outer surface of the body is quite smooth and bears no appendages or trace of segmentation; the large and very distinct opening found in the other *Rhizocephala*, which Delage calls the cloaca, is wanting in this genus. For the communication of the mantle-cavity with the exterior two rather small round holes alone are present, which were accurately observed and figured by M. Sars. From analogy I am of opinion that they were situated just within the limits of the damaged part of the body of *Sylon challengeri*; and a comparison with the figure of *Sylon schneideri* attached to *Hippolyte pusiola* (Pl. CXLIX. figs. 4, 5) will readily convince any one of the probability of this supposition. In fig. 5 a lateral view is given, and in fig. 4 a front view; in both figures the circular openings exist at *a*., and they are about 0·3 mm. in diameter. In young specimens these openings seem to be closed; at all events I observed them in this condition in a small specimen of *Sylon schneideri*, a transverse section of which is represented on Pl. CL. fig. 2. Like other Rhizocephala, *Sylon* carries its developing ova within the mantle-cavity; Kröyer's observations on the larvæ of this genus, and his comparison of these larvæ with those of *Sacculina*, admitting, I think, of no doubt on this point. Most probably the Nauplii, when ripe, leave the cavity by means of the above-mentioned openings. Running from between the two openings towards the place of attachment, a narrow stripe is visible through the transparent outer wall on both sides, limited by a distinct clear line (Pl. CXLIX. fig. 4). Here the body of the *Sylon* seems to be attached to the interior of the mantle, and probably this stripe is comparable to the "mésentère" of Delage.

When I commenced my investigations I did not know the nature of the parasite, and I therefore decided upon studying it by means of transverse sections. I was obliged to detach it from its rather bulky host, taking away along with the parasite an annular part of the body of the Shrimp. Fig. 2, Pl. CXLIX. was made after the animal had been thus loosened, and represents it from below. The round smooth part (*e*) afterwards proved to be the very dense mass of ovarian tubes. The outer covering was so loosely connected with the interior, that I was obliged before embedding it in paraffin to take it quite away; and in so doing I neglected to investigate microscopically the mode in which

the parasite was attached to its host. In the case of *Sylon schneideri*, however, I observed that the connection takes place in much the same way as Delage has described it in *Sacculina*. From a well-developed and rather voluminous basis (the "membrane basilaire" of Delage) numerous roots pass into the interior of the host, and in order to investigate this attachment it is necessary to make transverse sections of the host with the parasite attached to it. A part of the abdomen (the dorsal half having been removed) of a small specimen of *Hippolyte pusiola* with the *Sylon* attached, was embedded in paraffin in the usual way, and sections cut with the aid of the microtome.

Some of the sections so made are shown in Pl. CL. figs. 4–6. As it is not my intention to publish here an elaborate anatomical and histological description of *Sylon*—since both in regard to quantity and quality the material at my disposal was not sufficient—but only to give a preliminary orientation with regard to these little-known animals, a few words must suffice to describe this basilary membrane. It forms a circular disc equal in area to about one-fifth of the whole surface of the *Sylon*, and is not very thick, in the preparation shown in Pl. CL. fig. 4 measuring only about 0·2 mm.; it is composed of connective tissue, the nuclei being very small and numerous. The roots are not very abundant, but rather elongate and much ramified. In one respect there seems to exist an interesting difference between *Sylon* and *Sacculina*—in the latter genus the roots penetrate within the body of the Crab until they reach the wall of the intestine, but in *Sylon*, on the contrary, they as a rule do not reach so far. In *Carcinus mænas*, at the place where *Sacculina* is attached, the distance between the basilary membrane and the wall of the intestine is inconsiderable; in *Sylon* the same membrane is separated from the wall of the intestine by a dense mass of muscles (Pl. CL. fig. 4, *m*). Most of the roots (Pl. CL. figs. 4, 5, *r*) terminate on the ventral aspect of this mass of muscles, and only one root could be followed running close to the lateral surface of the abdomen of *Hippolyte* and directed to the dorsal part of the body. Most probably therefore *Sylon* lives, at least partly, on the blood of its host, and only to a limited extent draws its nourishment from the intestinal contents. Branches of these roots surround the central nervous system, passing through the abdomen in a very curious way (Pl. CL. figs. 4, 5, *n*).

According to Delage the basilar membrane and the roots belong to the internal part of the Rhizocephalid, the external part consisting of the visceral mass and of the mantle. The name "visceral mass" is perhaps not quite exact, as there is no trace of viscera, in the ordinary sense of the word (intestine, &c.), the contents being made up almost exclusively of one organ, namely, the very bulky ovary. After soaking in absolute alcohol, the ovary forms a very compact and hard body, which cannot easily be stained, is very brittle, and causes great trouble when cutting sections. It consists of extremely numerous more or less unripe eggs; in the specimens I investigated almost nothing could be observed of the true ovarian tubes, the ova being closely packed together in almost every direction. The latter are all nearly in the same condition of ripeness; each con-

tains a granular plasma and numerous clear vesicles scattered through its substance. As a rule a small nucleus is visible close to the wall of the ovum, which is distinctly coloured by alum carmine. The size of the eggs is much the same throughout the whole ovary; in *Sylon challengeri* (Pl. CL. fig. 1) they are nearly spherical, with a diameter of 0·06 mm., in *Sylon schneideri* (fig. 7) they are oval and slightly larger, the dimensions being 0·08 by 0·06 mm. Here and there between the ovarian eggs, especially in *Sylon challengeri*, stripes of connective tissue with rather large oval nuclei are visible.

The visceral mass is inclosed by an epithelium which is truly chitinogenous, and has a chitinous outer wall at its surface. This chitinous membrane—at all events when the animal carries no eggs in the mantle cavity—is pressed against a similar membrane, which forms the inner surface of the mantle. The latter organ consists of two layers of epithelial cells, separated from one another by connective tissue and muscular fibres; at the outer surface a rather thick and very resistant chitinous membrane is secreted by the epithelial cells, whereas the inner coating of chitin is thin and in not quite full-grown specimens is fused with the exterior chitinous membrane of the visceral mass. At the places where later on the openings of the mantle are formed, a thick, lenticular, chitinous disc (Pl. CL. fig. 2) is observed. The chitinous membrane at the surface of the mantle in the same preparation is distinctly double, but when the process of exuviation takes place the outer layer probably carries away the lentiform disc also, and so opens the genital pores. Between the two chitinous membranes of mantle and visceral mass the mantle cavity is formed by a simple parting of the two membranes.

In the series of preparations of *Sylon challengeri*, the gland, whose secretion serves probably for gluing the eggs together, is seen to be distinctly developed; but I observed only one gland, and not two as is the case in *Sacculina*. One of the sections of the gland is shown on Pl. CL. fig. 1, which fairly well corresponds to the description of it given by Delage in the case of *Sacculina*. He calls it the cement-gland, a name, which, as Giard pointed out,[1] is inexact, for it has quite the function of an "Eikittdrüse," or "glande collétérique." It is a tubular gland, much ramified, and very irregularly convoluted, and a kind of chitinous membrane is seen everywhere within the interior of the different parts. The gland as a whole, with the connective tissue between its convolutions, forms a lentiform mass. In *Sylon challengeri* the opening of the female genital apparatus does not take place, as is the case with *Sacculina*, by means of a vestibule (the atrium of Delage) situated in the centre of the mass of the gland; for I did not find a trace of such an atrium in any one of an uninterrupted series of preparations, all the sections being perpendicular to the surface of the lentiform glandular mass. At one side of the gland, however, the epithelium of the surface of the visceral mass forms a distinct invagination (Pl. CL. fig. 1, *d*), and perhaps the opening of

[1] A. Giard, Sur l'orientation de Sacculina carcini, *Comptes rendus*, March 10, 1886.

the female genital apparatus is to be sought here; in that case the tubular gland ought to have its opening in the neighbourhood of this invagination also.

Only in one of the specimens of *Sylon schneideri* did I observe anything that could be considered to be a testis, and this structure formed an oval compact gland, in connection at one extremity with the wall of the visceral mass, the other extremity lying free between the ovarian cæca. The organ which M. Sars observed and regarded as a testis is probably the same. In one respect, however, I do not agree with him, for he believes that he observed a small pore at the surface of the mantle, and considers it to be the male genital pore, while I, on the contrary, believe that the testis communicates by means of an opening with the mantle cavity. In Pl. CL. figs. 5, 6, sections of the testis are represented, figs. 4, 5, and 6 being from the same series; the preparations follow one another in sequence, from behind forwards, but numerous sections between them are not figured. Continuing the series of preparations in the same direction, soon after the one figured in fig. 6, one follows in which the openings of the mantle cavity are visible.

The nervous system was observed in *Sylon schneideri*. The only part of it which I found was an almost spherical body, composed of small cells with distinct and well-stained nuclei, and situated at the surface of the visceral mass, enclosed in a mass of connective tissue (Pl. CL. fig. 2, *n*). Its diameter is about 0·08 mm. In all the sections passing through it there is represented a clear central mass, probably consisting of granular substance, which is characteristic of the nerve-centres of the Arthropoda. In fig. 3 a part of another section, not far in front of that shown in fig. 2, and belonging to the same series, is represented. Here the connective tissue surrounding the nerve centre in fig. 2 is seen to be still more distinctly developed, and encloses a mass of granular substance, which in fig. 2 is just beginning to appear (figs. 2, 3, *l*). I do not know its nature; probably it is blood-serum.

The structure of the Rhizocephalida, so far as regards *Sacculina*, is now well known. Of *Peltogaster* our knowledge is rather insufficient; of *Clistosaccus* and *Sylon* almost nothing was known hitherto, and though for the latter genus at least some information is given in this note, much more data are wanted before it will be possible to discuss the affinities, not only of *Sacculina* and *Peltogaster*, but of all the members of the interesting family Rhizocephalida.

APPENDIX B.

Pontoniidæ (p. 705).

First pair of antennæ having the outer flagellum bifid. Mandible without a synaphipod. First pair of pereiopoda subequal, slender, chelate. Second pair unequal, one being extremely large, possibly in the male only.

Caricyphidæ (p. 712).

Body slender, carapace anteriorly produced to a slender sharp-pointed rostrum. Third somite of pleon dorsally frequently elevated and compressed. First antennæ having two short flagella; second pair having the scaphocerite long and narrow. First and second pairs of pereiopoda chelate, subequal. Telson long and slender.

Acanthephyridæ (p. 723).

Animal smooth, laterally compressed, and dorsally carinated. First pair of antennæ having two long flagella; second pair furnished with a sharp and rigid scaphocerite. Mandibles furnished with a synaphipod. First two pairs of pereiopoda slender, subequal. Telson long, narrow, and tapering to a truncated point.

Palæmonidæ (p. 711). Transfer to p. 778.

Nematocarcinidæ (p. 800).

Animal smooth and slender. First pair of antennæ having two long slender flagella. Second antennæ having a long and narrow scaphocerite, and a long and slender flagellum. Mandibles having a synaphipod. Pereiopoda having the carpos much longer than the propodos. First two pairs chelate, small, slender. Telson slender and tapering.

Tropiocaridæ (p. 824).

Carapace not laterally but dorsally compressed. Frontal regions anteriorly projecting above the ophthalmopoda, and produced to a short pointed rostrum. First antennæ having two flagella. Second with a long and narrow scaphocerite. First two pairs of pereiopoda subequal, slender, and chelate. Telson long and tapering.

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